

Cederberg vegetation and flora

H.C. Taylor



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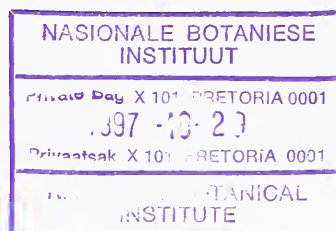
Cederberg vegetation and flora

by

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Private Bag X101, 0001 Pretoria

ISBN 1-874907-28-5

1996

STRELITZIA

This is the third occasional publication of the National Botanical Institute to appear under the series name *Strelitzia*. The new series has replaced *Memoirs of the Botanical Survey of South Africa* and *Annals of Kirstenbosch Botanic Gardens* which the NBI inherited from its predecessor organizations.

The genus *Strelitzia* occurs naturally in eastern southern Africa. It comprises three arborescent species, known as wild bananas, and two acaulescent species, known as crane flowers or bird-of-paradise flowers. The logo of the National Botanical Institute is based on the striking inflorescence of *Strelitzia reginae*, a native of the Eastern Cape and KwaZulu-Natal that has become a garden favourite worldwide. It symbolizes the commitment of the National Botanical Institute to provide the facilities, knowledge and expertise necessary to ensure the conservation, sustained use, appreciation and enjoyment of South Africa's exceptionally rich flora and vegetation.

Cover: The northern Cederberg (Groenberg 181) looking east toward the Tanqua Karoo, 1986-03-05.

ISBN 1-874907-28-5

© Published by and obtainable from: National Botanical Institute, Private Bag X101, Pretoria 0001, South Africa. Typesetting: S.S. Brink (NBI). Reproduction and printing by: Aurora Printers, P.O. Box 422, Pretoria 0001. Tel. (012) 327-5073.

Contents

ABSTRACT 1

UITTREKSEL 1

1. INTRODUCTION 3

2. PHYSICAL ENVIRONMENT AND HISTORICAL PERSPECTIVE, by H.C. TAYLOR, D.P. BANDS & J.C. SCHEEPERS 5

 Topography and geomorphology 5

 Soils 7

 Climate 7

 Land use and the biota 8

 History of vegetation description 9

3. FLORISTIC CLASSIFICATION OF THE NORTHERN CEDERBERG 11

 Introduction 11

 Methods of sampling and synthesis 11

 Classification 12

 The plant communities 12

 A. Thicket of fire-protected kloofs and screes (Communities 1–4) 14

 1. River kloofs (Communities 1 & 2) 14

 2. Scree and sand (Communities 3 & 4) 15

 B. Fynbos of well-drained habitats (Communities 5–19) 16

 1. Rocky habitats (Communities 5–16) 17

 1.1. Non-colluvial rock slopes and platforms (Communities 5–12) 17

 1.2. Colluvial rock slopes (Communities 13–15) 23

 1.3. High-altitude rock slopes (Community 16) 25

 2. Sandy habitats (Communities 17–19) 25

 C. Fynbos of poorly drained habitats (Communities 20–26) 29

 1. Mid-altitude plateaux and terraces (Communities 20–24) 29

 1.1. Winter-wet habitats (Communities 20–23) 29

 1.2. Permanently moist habitats (Community 24) 32

 2. Summit platforms (Communities 25, 26) 33

 Discussion and conclusions 34

 Method 34

 The structural classification of Campbell (1985) 34

 Habitat-floristic relationships within the study area 35

 Comparison with other regions 35

 Biotic influences 36

4. FLORISTIC ANALYSIS 37

 Introduction 37

 Comparison of three local floras 37

 Family and genus sequences in the Cederberg 38

 Conclusions 40

ACKNOWLEDGEMENTS 41

REFERENCES 43

CHECKLIST 47

APPENDICES 63



Clanwilliam cedar, *Widdringtonia cedarbergensis* about 8 m tall, growing on typical 'rock turrets' in the Welbedacht area.

Abstract

As an introduction to a study of the vegetation of the Cederberg, an important catchment in the drier northern part of the Western Cape, the geology, physiography, soils, climate, land use, biota and historical background are described. The discussion provides a broad contextual and environmental framework for the subsequent vegetation classification.

In the vegetation study of the northern Cederberg, the Braun-Blanquet method of sampling and analysis revealed 26 plant communities in two major structural and chorological units, thicket and fynbos. Thicket occurs on sites that provide natural protection from fire; fynbos is found in fire-prone habitats. Soil drainage appears to be the fundamental factor separating fynbos on well-drained slopes from fynbos on level sites with impeded drainage. Further subdivisions correlated with soil origin, depth, rockiness and altitude show that the floristic hierarchy is well correlated with environmental factors. Standard descriptions of each community provide a synopsis of vegetation structure and floristics, environmental influences and special features. The relationships between vegetation and habitat are illustrated by diagrams, photographs and a phytosociological table.

Floristic analysis, and comparison with two mountain floras in the southwestern Cape (Cape Hangklip area and Cape of Good Hope Nature Reserve), reveal that the Cederberg flora has links not only with the fynbos of the Cape Floristic Region but also with the dry winter rain shrubland of Namaqualand and the western Karoo. The checklist of the vascular plants in the Cederberg Wilderness and Mountain Catchment Area, records a total of 1 778 species.

Uittreksel

As inleiding tot 'n studie van die plantegroei van die Cederberg, 'n belangrike opvanggebied in die droër noordelike deel van die Wes-Kaap, word die geologie, fisiografie, gronde, klimaat, bodembenuutting, biota en geskiedkundige agtergrond beskryf. Hierdie bespreking verskaf 'n breë kontekstuele en omgewingsraamwerk vir die daaropvolgende plantegroei-klassifikasie.

Deur toepassing van die Braun-Blanquet-tegniek op die plantegroei van die noordelike Cederberg, word 'n totaal van 26 plantgemeenskappe in twee hoofstrukturele en -chorologiese eenhede erken: ruigte en fynbos. Ruigte kom voor op plekke wat natuurlike beskerming teen brand bied, terwyl fynbos op plekke gevind word wat aan brand blootgestel is. Die fynbosplantgemeenskappe word eerstens op grond van gronddreinerings verdeel in fynbos teen goedgedreineerde hellings en dié op gelyktes met belemmerde dreinerings. Verdere onderverdelings toon dat die floristiese hiërargie goed gekorreleer is met omgewingsfaktore soos grondoorsprong en -diepte, rotsagtigheid en hoogte bo seevlak.

Standaardbeskrywings van elke plantgemeenskap verskaf 'n oorsig van plantegroei-struktuur en floristiese eienskappe, omgewingsinvloede en spesiale kenmerke. Die verhoudings tussen plantegroei en habitat word deur middel van diagramme, foto's en 'n fitososiologiese tabel geïllustreer.

Die floristiese analise en vergelyking met twee bergfloras in die Suidwes-Kaap (Kaap Hangklip-gebied en Kaap die Goeie Hoop Natuurreservaat) toon dat die Cederbergflora nie net met die fynbos van die Kaapse Floristiese Streek skakel nie, maar ook met die droë winterreënstruikveld van Namakwaland en die westelike karoo. 'n Totaal van 1 778 spesies vaatplante wat in die Cederberg-wildernis- en bergopvanggebied voorkom, word gelys.

1. Introduction

The Cederberg* lies east of the towns of Clanwilliam and Citrusdal in the Olifants River valley, between latitudes 32°00' and 32°45' south and longitudes 18°50' and 19°25' east. The range is about 90 km long and 25 km wide at its widest point near the middle. It is traversed by three roads: the main road from Clanwilliam over Pakhuis Pass in the north, a secondary road from Clanwilliam to Ceres in the central part, and the main road between Citrusdal and Ceres which crosses a narrow sector in the southern part.

Most of the vegetation is mountain fynbos but Karoo elements penetrate the deep valleys of the tributaries of the Doring River on the east side and, on the west, a karroid zone extends southward from Clanwilliam into the valleys of the Jan Dissels and Rondegat Rivers.

The mountain fynbos of the Capensis Region (Taylor 1978; Kruger 1979a), the Cape Floristic Region (Kruger 1979b) or the Fynbos Biome (Campbell 1985), with its exceptionally rich flora and high degree of endemism (Hall 1981), is in urgent need of carefully planned conservation management and development. The Cape floral kingdom is home to many useful herbs and medicinal plants, and its showy components, especially the Proteaceae, are the mainstay of an important wildflower industry (Davis 1990). Man's impact on this rich and diverse flora has been severe. Only 39% of its former area remains and fynbos now has the highest concentration of threatened plants of any temperate region (Hall 1980; Hilton-Taylor in press). Introduced woody plants have invaded and displaced the wild vegetation on a large scale (Taylor 1969; Hall & Boucher 1977). The conservation of mountain fynbos is therefore of high priority, not only on account of its water- and soil-holding capacity but also for its scientific importance, aesthetic appeal, recreational value and economic potential. But sound conservation must be based on informed management, and the first step in informing managers is to provide a framework of community data obtained from phytosociological surveys (Taylor 1962, 1963). The phytosociologist, in analysing, describing and classifying plant communities, creates the hierarchy of vegetation units and indicates the relationship of these units to one another and to their habitats. The experimental researcher and autecologist must subsequently provide an understanding of the dynamic processes involved, and from

these derive management principles appropriate to each unit.

Accordingly, proposals for a semi-detailed phytosociological survey of selected mountain catchments were made (Taylor 1980, 1981) and adopted by the Forestry authorities. Campbell (1983, 1985, 1986a & b) has produced a primary survey of mountain fynbos for the whole Fynbos Biome using a classification based mainly on structural attributes of the vegetation. Campbell's important work will be discussed in Chapter 3. However, as a foundation for detailed resource assessment studies (Müller 1983) there remains a need for more detailed surveys which will provide an inventory of all species within each plant community. A trial of survey methods in the Cape of Good Hope Nature Reserve in 1969 (Taylor 1984a & b) led to the adoption of a floristic method based on the Zürich-Montpellier approach described by Mueller-Dombois & Ellenberg (1974) and Werger (1974).

Plant community studies in mountain fynbos have hitherto been concentrated in the south-western, southern and eastern parts of the Capensis Region, e.g. Bond (1981), Cowling (1984), Van Wilgen & Kruger (1985) and Boucher (1988). The northwestern extension of Acocks's (1988) Veld Type 69—Fynbos—has been largely neglected despite the presence of three major State Forests—Hawequas, Groot Winterhoek and Cederberg—and their adjoining mountain catchments. Surveys of Swartboschkloof (McDonald 1988) and in the Langeberg (McDonald 1993a, b & c) have been completed.

The veld types survey of South Africa by Acocks (1988), based on land potential, provided the first significant classification of vegetation for land use planning in this country on a broad landscape scale. For detailed planning and management within veld types, more precise methods have been adopted.

The Cederberg is the home of several rare, endemic or commercially exploitable plants. The endemic Clanwilliam cedar, *Widdringtonia cedarbergensis*, has been felled for sawtimber for over two centuries (Smith 1955), but studies on the effect of this exploitation and on the autecology of the species only began during this decade (Manders 1985). The mountain range forms the catchment of two rivers that irrigate arid lands both to east and west. By nature of its wild, spectacular scenery it has great potential recreational value (Ackerman 1972, 1979), and because it lies close to the northern boundary of the Cape Floristic Region its vegetation is of special scientific interest. The Ceder-

* The spelling 'Cederberg' was approved on 3rd April, 1981, by the (then) Minister of National Education (now Minister of Arts, Culture, Science and Technology) on the recommendation of the National Place Names Commission.

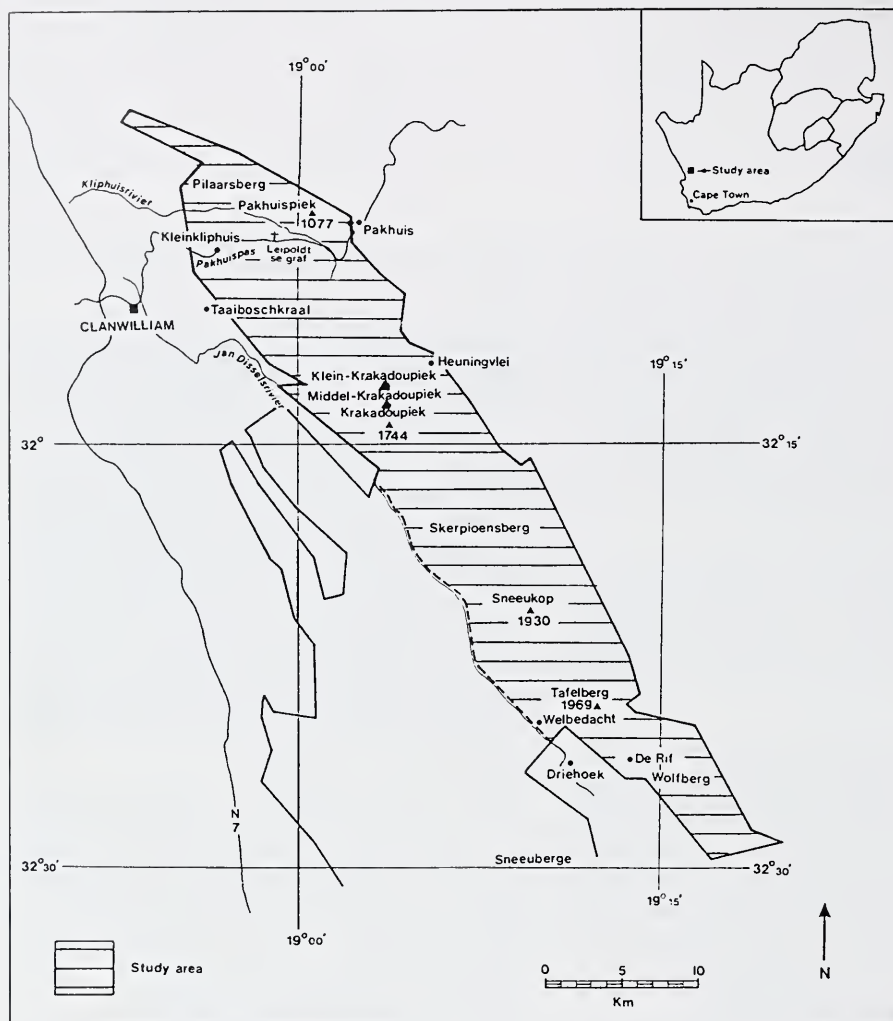


FIGURE 1.—Map of the study area in the northern Cederberg.

berg has been under State control for over a hundred years (Andrag 1977) and its management has posed problems to conservationists ever since, yet there has been no detailed floristic survey of the vegetation of the area.

The Cederberg is, moreover, a proclaimed Wilderness Area (Ackerman 1972; 1979; Van Zyl 1974)—one of the first in South Africa. It is essential, therefore, that the Cederberg should be managed as a 'shop window' where professionalism of conservation management is evident to its many visitors so that its status as true wilderness will be assured for the future. To this end, the phytosociological study of the Cederberg was undertaken, firstly to inform conservation managers on the habitats and plant communities in their care, and secondly to contribute data on a little-known category of fynbos to the inventory of plant communities in South Africa (Scheepers 1983).

This study was originally planned to cover the whole of the Cederberg Mountain Catchment Area (MCA) pro-

claimed in terms of the Mountain Catchment Act No. 63 of 1970 and currently managed by the Department of Nature and Environmental Conservation of the Cape Provincial Administration. This area comprises 67 000 ha of Forest Reserve that was already protected at the time of proclamation, and 59 000 ha of adjoining privately owned land. Most of the State land, 64 400 ha according to Erasmus (1984), was proclaimed a Wilderness Area by Government Notices in 1973 and 1976 (Bands 1978). The boundaries of the Wilderness Area, non-Wilderness State Forest and the Mountain Catchment Area are shown on the 1:50 000 Cederberg map compiled by the Chief Director of Surveys and Mapping.

After a reconnaissance of the whole MCA in 1985 it was decided, for practical reasons, to limit the semi-detailed survey to the northern and northeastern part of the Cederberg (Figure 1) including the cedar regeneration study sites in the Welbedacht-Wolfberg area. Data gathering began in January 1986 and was completed towards the end of 1987.

2. Physical environment and historical perspective

H.C. TAYLOR*, D.P. BANDS** and J.C. SCHEEPERS***

Topography and geomorphology

The Cederberg lies close to the northern limit of the Cape Fold Belt of mountains that dominate the Capensis Region. In the Cederberg the range trends in a northwesterly direction. The mountains were formed by upthrust and folding of the sedimentary rocks and subsequent extensive faulting. The drainage follows fault lines and angular lines of weakness in the sandstone beds, giving rise to a typical rectangular pattern. The quartzitic sandstones are relatively resistant to weathering, the shales and mudstones of the 'shale bands' less so.

The mountains rise steeply from the Olifants River valley in the west. Citrusdal, at about 170 m above sea level, is barely 17 km from Sneeuuberg which, at 2 027 m, is the highest peak in the range. Further north, the difference in altitude between the summit of Krakadouw Peak and the Jan Dissels River, 4 km westward, is 1 450 m. The Cederberg is the northern spine of the watershed between the Olifants River to the west and the Tankwa-Doring River system to the east (Figure 2). The mountain range is breached in the centre by a valley. From the divide at Uitkyk Pass, the Rondegat River runs roughly northwest to join the Olifants River at the head of the Clanwilliam Dam. The Driehoeks River, later the Matjies River, flows slightly south of east into the Doring River which meanders northward and westward, finally cutting through the Nardouw Mountains to join the Olifants River not far from its mouth. The Cederberg Mountain Catchment Area is an important part of the total catchment of the Olifants River system.

The topography is typical of regions where an arid climate with pronounced seasonal differences in temperature and precipitation controls the erosion cycle. The Table Mountain Group in the Cederberg is relatively little folded and tilted so that the flatish mountain tops are almost horizontal (Figure 3). This gives rise to a typical weathering pattern of massive rock groups sculptured by wind and weather into remarkable and characteristic shapes, separated by sandy flats or parallel fissures. The topo-

graphic sequence from valley bottom to mountain top is typically as follows: lower boulder-strewn slopes—steeper talus slopes—steep bare broken rock or cliffs—narrow plateau-like step, the 'trap' or 'shale band'. From this step the sequence is repeated, the upper cliffs being topped by very small to quite extensive plateaux. 'High cliffs, bouldery lower slopes and prominent scarps and crests contrast with extensive basins and subsummit plateaux' (Campbell 1985).

The Cederberg is built almost entirely of the sedimentary rocks of the Table Mountain Group within the Ordovician to Devonian Cape Supergroup, with some remnants of the older Malmesbury shales near the Olifants River in the west (e.g. at Patrysberg) and an abrupt transition to the younger Bokkeveld formations along the Moordenaarsgat River to the east.

Four formations of the Table Mountain Group of the Cape Supergroup (South African Committee for Stratigraphy 1980) are represented in the Cederberg. From top to bottom these are:

1. The Nardouw Formation, consisting of coarse-grained orthoquartzites, with occasional pebbles and lenses of vein quartz (Truswell 1970). It is characteristically redder than the Peninsula Formation and the dense linear drainage or weathering pattern is distinguishable on aerial photographs. In the Cederberg this formation is prominent in the plateau-like summits north of Pakhuis Peak and on Sneeuukop, Tafelberg and other peaks above the shale band. North of the Cederberg it builds the Nardouw Escarpment, and in the south forms the Skurweberg Range of the Bokkeveld.

2. The Cederberg Formation (the shale band) is composed of shale and siltstone interbedded with fine-grained sandstone. It is a feature in the landscape, forming a narrow green band that contrasts sharply with the bare rocky quartzites below. It is fossiliferous, and lacks the pockmarks or 'heuweltjies' characteristic of the Malmesbury and Bokkeveld shales.

3. The Pakhuis Formation is the thin layer of tillite, or glacial mudstones and related rocks, immediately below the shale band. It contains random-sized pebbles some of which have been faceted and striated during the movement of ice over the underlying rock pavement. On Pakhuis Pass and at Groenberg remnants of the glacial

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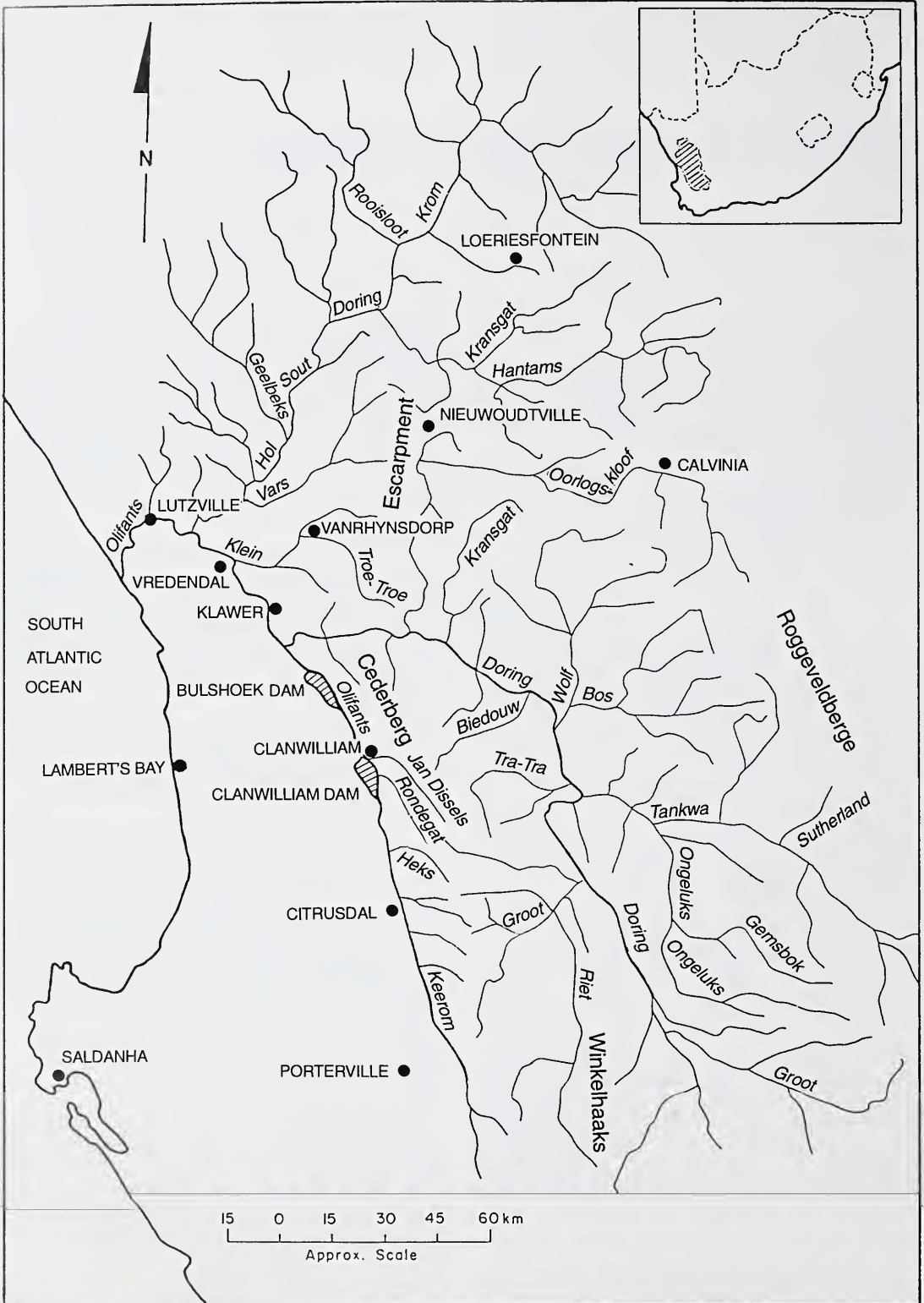


FIGURE 2.—The Olifants River catchment. From Morant (1984) redrawn from Scott (1982).



FIGURE 3.—Very broken country south of Pakhuis Pass where the high sandy plateaux drop step-wise to a lower level in the west. Vegetation is a fragmented mosaic of Sand Thicket Community (No. 4), Peninsula Bedrock Communities (Nos. 6 & 7) and Sandflats Community (No. 18). Beyond is the Pakhuis shaleband and the Pakhuis range. Note the level rock strata.

pavement are exposed, showing the deep irregular grooves made by the passage of the ice.

4. The Peninsula Formation, like the Nardouw, is a very thick deposit of coarse-grained quartzitic sandstones with occasional white quartz pebble deposits. Sand-shale lenses of various sizes occur throughout this formation. This formation comprises all those parts of the Cederberg from which the upper strata have been eroded away, i.e. southward from Pakhuis Pass, including Krakadouw, Mid-delberg, Vensterberg and Maraisberg, but excluding the eastern peaks from Sneeuokop to Sandfontein.

Two other formations, the Graafwater Formation (purple to pink thinly bedded sandstone, siltstone and shale—the former 'lower shale' and the Piekenier Formation (conglomerate and sandstone) do not occur in the Cederberg. They are the lowermost strata of the Table Mountain Group and can be seen in road cuttings on the western side of Piekenierskloof Pass. Rust (1967) describes all these formations in great detail.

Soils

Soils of the western mountains are coarser textured than those in the eastern parts of the Fynbos Biome. Cederberg soils are often yellow-brown to brown, rather than greyish in colour (Campbell 1983). This may be because quartzites in the northern areas are apparently higher in iron oxides than elsewhere in the fold zone (Lambrechts 1979).

Except for small pockets of sandy loam to clay loam soils, generally derived from the shales and mudstones of the Cederberg Formation, soils are highly leached acid sands, low in nutrients and with low moisture-retaining capacity. On rocky slopes, soils are skeletal and mainly of the Mispah and Glenrosa Forms, porous with rapid internal drainage and therefore resistant to normal water erosion. There is little mass wastage. Accelerated sheet erosion is sometimes observed after fires. On plateaux or wherever there is a break in slope where materials accumulate, deep sands develop giving rise to soils of the Fern-

wood Form. These are usually highly susceptible to gully erosion.

Smit (1970) gives the milli-equivalent cation absorption capacity of upper Olifants River soils near Citrusdal, as below 4, often as low as 2, with pH from 4.5 to 6.5. It can safely be assumed that the soils of the catchment are as poor in nutrients or poorer than these.

Climate

The mediterranean climatic cycle in the Fynbos Biome, with wet winters and dry summers, has been described in broad terms by many authors (e.g. Jackson & Tyson 1971; Kruger 1979a; Fuggle 1981). In more detail, Fuggle & Ashton (1979) have summarized the variation in climatic elements such as solar radiation, temperature and rainfall; Campbell (1983) has analysed this variability in relation to environmental gradients, and Van Wilgen (1984) has divided the fynbos climate into fire climate zones for the purposes of fire management.

Climate stations are conspicuously absent from the mountainous areas of the Fynbos Biome, especially in the northwest (see, for instance, fig. 1 in Fuggle & Ashton 1979). Climate diagrams and detailed comparative data are unfortunately not available and only some generalizations can be made.

First, the proportion of winter rain is highest in the west of the Biome and precipitation decreases northwards. The Cederberg, which is among the most westerly and northerly of fynbos mountains, receives at least 80% of its rain in the three winter months but its annual total is lower than in most other Cape mountains. Secondly, greater seasonal temperature ranges and higher annual pan evaporation are recorded in the west where greater amounts are evaporated during summer (Campbell 1983). Thirdly, there are local gradients in precipitation: increasing from low valleys to the high peaks, decreasing from the coast-facing to the interior sides of the mountains. Finally, there is the aspect gradient, with pronounced differences in radiation between north and south, the north

receiving much more energy than the equivalent south aspects, especially in winter (Campbell 1983).

All these factors make for great variation in the local climates of the Cederberg, with corresponding variation in vegetation. The mountains above 1 000 m receive much more rain than the valleys. Middelberg, for instance, has an average annual rainfall of 939 mm, Algeria in the valley below, 647 mm, and Kromrivier valley, further east, 407 mm (Bands 1978). Some of the high-altitude precipitation is in the form of mist, though there is less southeast cloud in summer than on the more southerly ranges. Precipitation decreases eastward and northward. Snow falls on the higher peaks nearly every winter but does not lie longer than a few days. Convection storms along the eastern margin usually occur in spring and autumn but are seldom accompanied by hail.

Night temperatures in winter frequently drop below freezing point and frost is common, especially on the higher plateaux. Summer temperatures frequently rise to 25°C or 30°C and extremes of over 40°C in January and February are not uncommon.

The prevailing winds (southeast in summer, northwest in winter) are not as strong or persistent as they are further south. Hot, dry northerly berg winds increase the fire hazard in the spring.

Land use and the biota

For millennia before European occupation, and until the latter half of the eighteenth century, both San (Bushman) and Khoi (Hottentot) clans lived in the Cederberg area. The San were hunter-gatherers and may have deliberately burned the veld to encourage game to concentrate and to stimulate growth and reproduction of edible bulbous plants (Klein 1974). In the final century of their occupation the San, harassed first by invading Khoi tribes and later by European frontier farmers (trekboere) retreated into the mountains and may have lived in the caves there for years with large herds of stolen livestock (Johnson 1979; Penn 1984). They have left rock paintings in overhangs at lower altitudes but seldom in the caves above 1 000 m.

The Khoi, occupying the coastal forelands, river valleys and lower mountain slopes, were pastoralists and are reported by a number of writers to have habitually burned the veld to provide pasture for their sheep (Brown 1875; Botha 1924; Mossop 1927; Thompson 1936; Schweitzer & Scott 1973). The Khoi may have used the Strandveld only as winter grazing and migrated annually into or beyond the mountains in summer.

Stock farming was the earliest activity of the trekboere who penetrated the west coast and Olifants River valley in the first half of the eighteenth century. These farmers used the mountains for grazing and adopted a patch-burn system of veld management which is still in use in some places today. The same treatment was used to encourage the production of buchu, *Agathosma betulina*, an aromatic shrub cultivated on a commercial scale for medicinal and pharmaceutical uses. In those days small homesteads and stock posts were scattered in remote parts of the Ceder-

berg and small patches of suitable ground were cultivated and planted to annual crops. These patches are now all abandoned but may still be recognized by the occasional shade tree and the degraded weedy vegetation that remain as testimony to this early mountain agriculture (Bands 1978).

From the time they were first reported in about 1760, the Clanwilliam cedars *Widdringtonia cedarbergensis* rapidly became an important source of timber. From the earliest written accounts of these woodlands (so-called 'forests') in 1805 (Smith 1955) to the time when all felling was finally stopped in 1967 (Bands 1978) the history of their ruthless exploitation has been well documented (for summaries, see Hubbard 1937; Smith 1955; Lückhoff 1971; Andrag 1977; Bands 1978; Manders 1981). Through over-exploitation, frequent fires and a possible increase in seed predation, the cedar populations have been reduced to a point where their recovery by natural regeneration may be problematical (Manders 1986). Recent research is aimed at improving the chances of survival of the species (Manders 1986; Manders & Botha 1989; Higgins *et al.* 1989; Botha 1990; Manders *et al.* 1990). Ever since about 1900 when Forester Bath drew up the first fire-protection scheme, manipulation of mountain vegetation, including the cedars, by fire or protection from fire, has been attempted (Clayton 1954; Bands 1977; Kruger 1977). Fire management is still the subject of experimental research (Kruger & Haynes 1978; Manders 1987a & b; Brown *et al.* 1991) and monitoring (Van Wilgen 1980).

The degradation of habitats was aggravated by both grazing and the harvesting of natural products of the mountains, for example buchu, bush tea [*Aspalathus linearis* (Burm. f.) R. Dahlgren] and tan bark [from *Protea nitida* Mill., *P. repens* (L.) L., *Heeria argentea* (Thunb.) Meisn. and *Colpoön compressum* P.J. Bergius]. On State Forest these practices were stopped between 1937 (grazing) and 1969 (bush tea) although emergency local grazing was allowed as late as 1967. On the privately owned land within the MCA, on the other hand, pasturing of sheep, goats and cattle, harvesting of buchu and wild flowers, and cultivation of bush tea are still practised today, and may be allowed to continue under control (Bands 1978).

Soon after 1897, when part of the Cederberg was declared a 'demarcated forest', a plantation of fast-growing exotic trees was established at Algeria to provide an alternative source of timber. At higher elevations, trial plantings of Clanwilliam cedar were also established but generally these have not thrived.

Since the proclamation of the Cederberg MCA in 1976, the foremost management objective on State land has been water conservation, followed by nature conservation and outdoor recreation. It is evident from Figure 2 that the MCA is an important part of the total catchment of the Olifants River.

Wild life in the Cederberg, according to Bands (1978, appendix 3) comprises 65 species of mammals, 193 birds, 8 amphibians, 48 reptiles and 14 fish. Mountains in the southwestern Cape have a fairly uniform fauna but the Cederberg, lying on the borders of the Karoo, harbours

certain Karoo species not usually found in fynbos mountains (Rautenbach & Nel 1980). Some noteworthy examples of such species are aardwolf, bat-eared fox, 'namtap' *Graphiurus ocularis* (Channing 1987), leopard, Clanwilliam yellow fish and black eagle. Rodent species are quite numerous and may be an important factor in predation on plant seeds. The fish fauna requires careful conservation: eight species are endemic to the Olifants River system, of which six are rare, vulnerable or endangered (Scott 1982). Aquatic systems are oligotrophic and would be particularly sensitive to enrichment (Scott 1982).

Bands (1978: appendix 2.2) gives a list of 63 rare, endangered, endemic or otherwise interesting plant species that may require special conservation management. Invasive alien plant species are no longer a serious problem on State land but need to be controlled on private land within the MCA. Bands (1978: appendix 2.3) records 13 invasives within the MCA. Among the most dangerous are, *Nerium oleander* L., *Prosopis grandulosa* Torr. var. *grandulosa* and *Sesbania punicea* (Cav.) Benth.

Regarding outdoor recreation patterns, Andrag (1977) found that swimming pools, both natural and man-made, are the greatest single attraction, and that only 23% of the total number of visitor groups to the State Forest actually hiked or slept overnight in the Wilderness. There is a need for careful regulation of the numbers and activities of people, not only to prevent degradation of ecosystems but especially to retain the Wilderness attribute of solitude.

History of vegetation description

Of the many pioneers who opened up the northwestern frontiers in search of the legendary copper mines and other spoils, none apparently penetrated the Cederberg. This is not surprising considering the inhospitable terrain, the unpredictable San (Bushmen) and the lack of incentive to explore the arid interior. The general impression gained from accounts of the Strandveld route is the variability in condition of the veld. Abundant grazing and clear, sweet water of the rainy season in good years alternated with barren sand, molehills, hard thorny bushes and muddy pools in the drought periods. On the other hand, early travellers who skirted the mountains reported much grass, good firewood, large forests and impenetrable scrub. Among these were Valentyn who travelled along the Piketberg in 1685 and Starrenberg who reported from near Porterville in 1705 (Skead 1980). Among those who later crossed into the Olifants River valley was Barrow in 1798 who found 'a new sort of country' and Alexander in 1836 who reported that a fine river 'ran full and clear between steep banks which were lined with mimosas and willows' (Skead 1980). In 1774 Thunberg, with Masson, did ascend the northern Bokkeveld escarpment to the Nieuwoudtville plateau and beyond to the Roggeveld, reporting bulbous plants everywhere and discovering the kokerboom, *Aloe dichotoma* Masson. The Cederberg, however, remained unexplored until Zeyher collected there in 1828 and again in 1831 when he met C.F. Drège. Apart from details of their plant collections, the only record of this expedition is the diary of Drège (Gunn & Codd 1981).

These early botanical travellers who ventured into the mountains were more concerned with collecting the flora than describing the vegetation. It was the brother J.F. Drège who, with E.H.F. Meyer, produced the first map and classification of the floral regions of the Cape in 1843. Later plant geographers of the nineteenth century, attempting to subdivide world biota, including those of South Africa, into biogeographical units, progressively improved the descriptions of the Capensis Region (Taylor 1978; Werger 1978), but Marloth (1908) was the first to make a detailed classification that included a specific description of the 'Cedarberg mountains'.

Since then there have been numerous but brief accounts of Cape mountain vegetation with some relevance to the Cederberg. Some writers described specific areas like the Hex River Mountains (Marloth 1896), the Little Karoo mountains (Leyvyns 1938), the Kamiesberg (Adamson 1938), the Olifants River Mountains (Milton & Linder 1980) and a portion of the Clanwilliam District (Milton 1978). Others covered wider topics such as the alpine vegetation of high peaks (Marloth 1929), the Cape/Karoo contact (Marloth 1923), the extent of the Cape flora (Marloth 1902) and overviews of broad vegetation zones (Taylor 1963; Taylor & Boucher 1973; Moll *et al.* 1984); but only two short papers (Taylor 1970, 1976) and a brief but interesting phytosociological account (Mustart *et al.* 1993) described specific plant communities in the Cederberg. Other works that incidentally dealt with the vegetation of the Cederberg—apart from the early accounts of the cedars referred to in the previous section and a popular account by Lückhoff (1980)—are those of Andrag (1977) and Bands (1978).

Andrag (1977) devised a simple community classification based on structure (height and percentage crown cover of the dominant stratum) with dominant species allocated to one of five physiognomic classes—grass, restio, shrub (narrow- and broad-leaved) and tree. By means of these categories he devised an ingenious classification consisting of seven basic vegetation units which could, if necessary, be further subdivided by the species that was dominant or conspicuous in each unit. The seven categories are: tall shrub-restioveld, low shrub-restioveld, waboomveld, shale-band vegetation, riverine scrub, dry kloof forest and wet kloof forest, the latter corresponding to the Knysna Forest, Veld Type 4 of Acocks (1988).

These were good enough for Andrag's purpose (characterization of the vegetation in relation to the occurrence of the Clanwilliam cedar) but for provisional management of the whole of the Cederberg, Bands (1978) felt that somewhat more detailed subdivision was necessary. He sought to obtain vegetation units that were identifiable on aerial photographs so as to allow mapping units of broad types without recourse to very expensive and time-consuming ground surveys. This he achieved by differentiating subtypes of Andrag's low shrub-restioveld and waboomveld, resulting in a total of twelve plant communities.

By using this system, Bands was able to state that, apart from a very few small remnants of forest akin to Acocks's Veld Type 4 to be found in sheltered kloofs, the

whole of the Cederberg vegetation could be classified as Acocks's Veld Type 69, Fynbos. A decrease in plant cover and in importance of Restionaceae and other fynbos forms and an increase in the number and variety of succulents in the vicinity of Clanwilliam and Pakhuis Pass in the north, and in the southeast between Matjiesrivier, Rietkloof and Pompieshoek, indicated the transition to Karoo vegetation (Acocks's Veld Type 31, Succulent Karoo; and 26, Karroid Broken Veld). Also evident was the abrupt change from fynbos to typical karooveld east of the fault line marked for much of its length by the

Moordenaarsgat River, which is also the contact line between Table Mountain sandstones and Bokkeveld shales.

Bands's classification, effective though it was for broad-scale interim management of the area, was based essentially on gross physiognomy of the vegetation. For sophisticated management and for monitoring the finer responses of vegetation to treatment, a classification based upon full floristic composition is required. The aim of this present study is to attain a classification of this kind.

3. Floristic classification of the northern Cederberg

Introduction

Campbell's (1985) structural classification of the mountain vegetation of the Fynbos Biome (which includes the Cederberg) is the first step from generalized to specific vegetation description after Acocks's (1988) veld types, but an evaluation of Campbell's work was not within the scope of my project as approved by the Botanical Research Institute (now the National Botanical Institute) in 1983. Hence, the structural data I collected, based on the simpler classifications of Campbell *et al.* (1981) and Edwards (1983), were insufficient to enable me to identify the communities of Campbell (1985) with certainty. Nevertheless, in my community descriptions I have attempted to make some broad comparisons with Campbell's structural units and to discuss these briefly in the final pages.

The northern ranges in the Fynbos Biome are mapped by Acocks (1988) as Fynbos (Veld Type 69) and by Moll *et al.* (1984) as Mesic Mountain Fynbos. However the latter authors state (p.19) that their concept of Mesic Mountain Fynbos in the Cederberg may prove to be more xeric than the typical form. This view is strengthened by the fact that some taxa characteristic of the moister southern parts of Mesic Mountain Fynbos, e.g. the family Penaeaceae and the genus *Mimetes*, are absent in the Cederberg and all other ranges north of the Cold Bokkeveld. It is likely too that the mountain vegetation of the Cederberg has been more degraded over the last two centuries than the majority of Cape ranges due to the ruthless exploitation of the Clanwilliam cedar and other economically important species, the heavy grazing by domestic stock until about 50 years ago (Bands 1978) and the frequent extensive wildfires of the last two or three decades.

Methods of sampling and synthesis

Sampling and synthesis were according to the Braun-Blanquet method described by Mueller-Dombois & Ellenberg (1974) and Werger (1974).

Where it was possible to recognize distinct physiognomic-physiographic units on the 1:40 000 aerial photographs, sampling sites were located on a stratified-random basis by means of random-dot templates placed over the aerial photographs. In very broken terrain where small and distinct communities were easily recognized on the ground, a degree of objectivity was achieved by pacing a fixed distance towards the centre of the community. The prime consideration, however, was always homogeneity of the vegetation, not randomness of the sample.

Because Cederberg vegetation is near the dry end of the fynbos gradient, it was thought advisable to determine

whether the quadrat size of 50 m², often used for fynbos, was suitable for this survey. The results of a nested-quadrat test (Werger *et al.* 1972) on a range of physiognomic types in the Cederberg showed that a size of between 50 m² and 100 m² would yield optimum information gained in relation to sampling time by the criteria of Werger (1972). Hence, our standard plot-demarcator of 5 m × 10 m divided by strings into ten equal subplots, was supplemented by a surrounding width of about 1.5 m to bring the total quadrat size to 100 m² for fynbos. In the coarser-patterned thicket vegetation, a variously shaped quadrat size of 200 m² was used. Nearly every quadrat was permanently marked with its number embossed on an aluminium tag placed usually in a stone cairn at the 'bottom left' corner of the rectangular plot. On level ground the length of the plot faced roughly north; on slopes the length was along the contour.

For each quadrat a standard form was used to list all species with their cover-abundance values according to the Braun-Blanquet scale. Species present only in the surround were designated 'O'. 'R' indicates 'rare'. The total cover of vegetation canopy, litter and rock was estimated in percentages and the following data were recorded: date of survey, location to the nearest one-ninth of a quarter-degree-square, land facet (Scheepers 1975) altitude, aspect, slope, geological formation (Rust 1967), substrate, and estimates of soil depth in centimetres, soil moisture, post-burn age of vegetation and amount of disturbance. In order to place each quadrat in the structural classifications of both Campbell *et al.* (1981) and Edwards (1983), the height of each stratum, its total cover and the cover in Braun-Blanquet values of various structural attributes of stems and leaves were recorded. Notes were made on dominant species, biotic influences, water regime, and pattern and extent of the community. The species list together with the abovementioned data for each quadrat is henceforth referred to as a relevé. A photograph, usually black-and-white, of nearly every relevé was taken.

The 157 relevés of the main survey (undertaken in 1986 and 1987) were supplemented by 23 taken during reconnaissance and 11 in riverine thicket (1988), bringing the total number to 191 relevés.

The PHYTOTAB package of programs (Westfall *et al.* 1982) was used to classify the vegetation according to Braun-Blanquet's phytosociological method.

Species occurring only once in the matrix were excluded from the phytosociological analysis. The geophytes and annuals that were not permanently recognizable were included in the non-diagnostic species (Group BI of Appendix 2) since their seasonal presence above-ground ren-

ders them unreliable as indicators of a plant community. Species that could not be named in the field were collected for identification; for those that were not identifiable, 'field specimens' were retained for matching with authenticated material. Taxa that could be identified only to genus level were given a collection number if they were individually collected. If not, the epithet sp. is appended, and then the concept may include several species within the genus. Where two taxa in vegetative condition were indistinguishable in the field they were of necessity 'lumped' and given a code name, e.g. *Ehrharta* c/v for *Ehrharta calycina* and *E. villosa*, *Ehrharta* b/c for *Ehrharta bulbosa* and *E. capensis*, and *Macrostylis* t/d for *Macrostylis tenuis* and *M. decipiens*.

At a late stage in the table-sorting process, 17 relevés that clearly appeared to be heterogeneous were removed from the matrix after having been evaluated. Though a few of these unclassified relevés may reflect transitional or unrepresentative situations, most of them probably represent minor communities sampled once only. The relatively high number of these demonstrates the high habitat diversity in much-dissected mountain topography. For the benefit of future workers, these 17 relevés have been included on the right-hand side of Appendix 2.

Classification

Since the nature of mountain fynbos communities over a wide range of habitats is as yet insufficiently known, the communities in the northern Cederberg have not been ranked in a formal hierarchy (Werger *et al.* 1972; Coetzee 1974). Nevertheless, the 26 communities revealed by the phytosociological analysis can be grouped naturally into larger units based on species with broader amplitudes. The floristic-habitat relationships in this informal ranking are shown in Figures 4–6.

In accordance with the recommendations for a standardized South African syntaxonomic nomenclature (Scheepers *et al.* unpubl.) each community name is based on two diagnostic species, the first a species of broader amplitude (if possible a dominant), the second a differential species, i.e. one with high presence and fidelity in the specific community being described. In the Cederberg, as in most mountain fynbos, some communities, especially impoverished communities under stress, as at high altitudes, lack good differentials. In such cases two species with wider amplitude but high presence within the relevant community were chosen for the name.

In the community descriptions, information is given in a standard format. The structural category, averaged for each community, is that devised for the vegetation of the Fynbos Biome by Campbell *et al.* (1981). This is followed by a list of relevés sampled (with the total number in brackets); the average and range of species richness; and a reference to the 'diagnostic species group' in Appendix 2. Finally there are standardized descriptions of the vegetation with the dominants listed separately; the locality and environment; and special features peculiar to each community. In the environmental description the land facet number (in brackets) refers to the classification of Scheepers (1975); the geological formation code (in brackets) is that given in the legend on the 1:250 000 Geological Series map, 3218 Clanwilliam sheet, published by the Government Printer, Pretoria, in 1973.

The plant communities

Two contrasting structural categories of vegetation are immediately apparent: fynbos and broad-leaved thicket. The latter, allied to Acocks's (1988) Veld Type 4, is rare in the Cederberg, occurring in river kloofs and on screes that provide natural protection from fire (Communities 1–4, Figure 4). Fynbos is the vegetation of all fire-prone habitats—probably over 95% of the area. The Cederberg

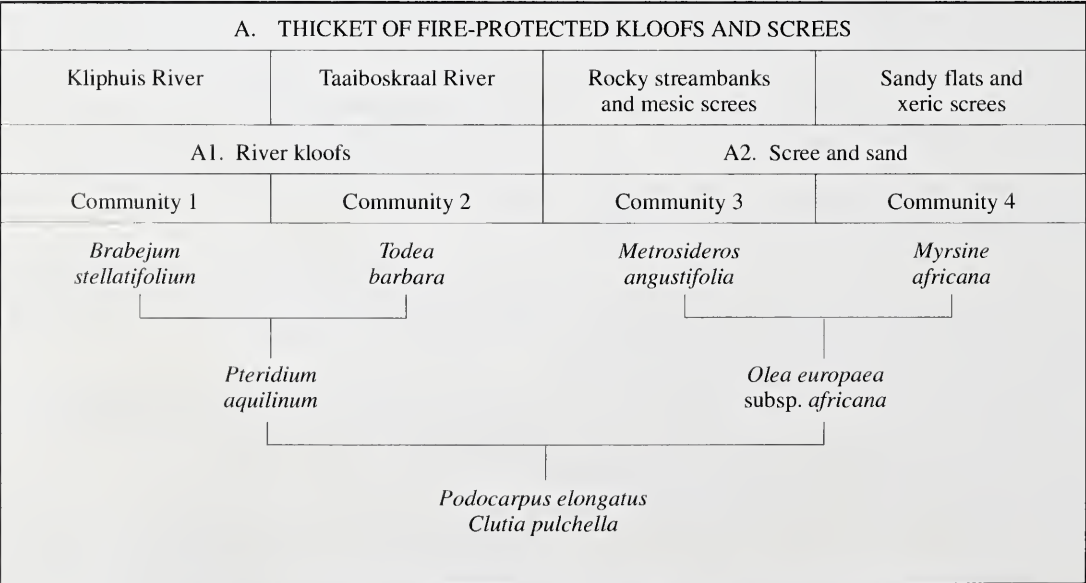


FIGURE 4.—Floristic-habitat relationships in the northern Cederberg: Thicket of fire-protected kloofs and screes.

C. FYNBOS OF POORLY DRAINED HABITATS						
C1. Mid-altitude plateaux and terraces					C2. Summit platforms	
C1.1. Winter-wet habitats				C1.2. Permanently moist habitats	High sandy platforms	Summit plateaux
Comm. 20	Comm. 21	Comm. 22	Comm. 23	Comm. 24	Comm. 25	Comm. 26
<i>Tetraria</i> sp. nov. (T 11230)	<i>Centella</i> cf. <i>recticarpa</i>	<i>Staberoha</i> <i>aemula</i>	<i>Ischyrolepis</i> <i>virgea</i>	<i>Elegia</i> <i>asperiflora</i>	<i>Restio</i> <i>strobilifer</i>	<i>Pentaschistis</i> <i>densifolia</i>
<i>Elegia filacea</i>				<i>Tetraria</i> sp. nov. (T 11230)*	<i>Ischyrolepis nana</i> *†	
<i>Ehrharta calycina/villosa</i> absent						
* of broader amplitude but constant and dominant in this group only.						
† included under <i>Ischyrolepis curviramis</i> in Table 2.						

FIGURE 6.—Floristic-habitat relationships in the northern Cederberg: Fynbos of poorly drained habitats.

has a simple geological structure but a complex variety of habitats broadly distinguished in the first place by amount and seasonality of soil moisture. Communities 5 to 19 (Figure 5) comprising by far the larger part of the area, occur on sites where drainage is good; communities 20 to 26 (Figure 6) occur at upper altitudes where the shallow soil is wet or waterlogged for at least part of the year. Further subdivisions are shown in Figures 4 to 6 and discussed in the text.

A. THICKET OF FIRE-PROTECTED KLOOFS AND SCREES (Communities 1–4)

Only two species, the tree *Podocarpus elongatus*, and the forest-margin undershrub *Clusia pulchella*, are exclusive to all four thicket communities in the northern Cederberg but neither have high presence except in the moister, best developed parts. Thickets were only sampled in the area from Krakadou northwards. There are no thickets in the Welbedacht area (Figure 1).

1. River kloofs (Communities 1 & 2)

Two river kloofs were sampled. The fact that each has a different community suggests that more extensive sampling is needed in this habitat type. In the northern Cederberg, River kloof thickets are found only along streams draining westward into the Olifants River.

Community 1 *Pteridium aquilinum*–*Brabejum stellatifolium* Community on sandy streambanks in the Kliphuis River kloof (Figure 7)

Structural category: low forest**

Relevés: (6) 181, 182, 183, 185, 186 & 187

Species richness: 14 (13–15)

Species group (Appendix 2): A

Vegetation: mature (except relevé 185) with 100% cover; two strata, the upper of trees 5–6 m, the lower of forest shrubs and bracken to 1.5 m.

Dominants: *Brabejum stellatifolium* (differential) and *Metrosideros angustifolia* (differential) in the tree layer, *Prionium serratum* in the shrub layer on sandy banks.

Locality and environment: only recorded in Kliphuis River kloof in relatively broad-based but deep kloofs (land facet 04) or, for relevé 185, upper watercourses (land facet 01), at altitudes below 550 m; almost level, on TMS of the Peninsula Formation (geological formation C1Q1) with a usually shallow substrate of humic sand, some stones, little rock (except relevé 183) and low litter cover—possibly due to seasonal flushing. Annual rainfall approximately 400 mm.

Special features: riverine situation at lowest altitudes on permanently wet soil despite low rainfall. Non-dominants with high presence are *Brachylaena neriifolia* (tree layer) and the restioid *Calopsis paniculata* (shrub layer). In the northern Cederberg *Rhus angustifolia*, common in thickets further south, is near the northern end of its distribution range and occurs occasionally in this community only.

** The classification of Campbell *et al.* (1981) does not have a category for thicket; their Low Forest in the Cederberg is roughly equivalent to the Short Thicket/Low Thicket categories in the national structural classification of Edwards (1983).



FIGURE 7.—*Pteridium aquilinum*–*Brabejum stellatifolium* Community (No 1) in the Kliphuis River Kloof, with trees 5–6 m tall. Dark crown on left is *Podocarpus elongatus*.

Community 2 *Pteridium aquilinum*–*Todea barbara*
Community on sandy streambanks in the Taaiboskraal River kloof

Structural category: low forest
Relevés: (3) 188, 189 & 191
Species richness: 13 (12–14)
Species group (Appendix 2): nil

Vegetation: mature, 97–100% cover; two strata, the upper of trees 5–8 m, the lower of ferns and moisture-loving shrubs to 1.5 m. No diagnostic species.

Dominants: *Metrosideros angustifolia* in the tree layer and the distinctive restioid *Elegia capensis* in the shrub layer.

Locality and environment: only recorded in the Taaiboskraal River kloof along more or less incised watercourses (01, 03, 04) at altitudes around 650–750 m; slope 1°–3°, aspect WSW, on TMS of the Peninsula Formation (C1Q1) with 500 mm or less of sandy humic soil over bedrock and again low cover of litter; annual rainfall 600–700 mm.

Special features: as in Community 1, permanently wet soil but higher rainfall; vegetation similar to Community 1 but for the absence of *Brabejum stellatifolium* and several forest shrubs, the strong dominance of *Metrosideros angustifolia* (B–B cover 5), less bracken but several other fern species, and *Clutia pulchella* with low but consistent presence.

2. Scree and sand (Communities 3 & 4)

These communities are richer in species and more diverse in habitat than the river thickets. They share with the Bedrock communities several species (Group K, Appendix 2) that thrive in rocky situations protected from fire. The form of *Cassine peragua* that occurs in these thickets has very narrow leaves and is easily confused with *Hartogiella schinoides*.

Community 3 *Olea europaea* subsp. *africana*–*Metrosideros angustifolia* Community on rocky streambanks and mesic screes

Structural category: low forest
Relevés: (5) 20, 44, 55, 140 & 190
Species richness: 23 (14–31)
Species group (Appendix 2): nil

Vegetation: mature but patchy, with canopy gaps: cover 80–100%; usually two strata, the upper 5–9 m tall, the lower 0.5–1.5 m, but relevé 20 on a moist, cool slope has an additional layer of tall undershrubs to 2.5 m. No diagnostic species.

Dominants: in the tree layer, *Metrosideros angustifolia*, *Heeria argentea*, *Podocarpus elongatus*, locally *Hartogiella schinoides* and *Maytenus oleoides*; locally in the shrub layers *Diospyros glabra* and *Myrica serrata*.

Locality and environment: scattered throughout the northern sector from Krakadoupoot to beyond Ribboksberg, including a gallery thicket on an east-flowing stream at Fortyn-se-Kloof (Relevé 55); land facets: stream ravines (03), plane slopes (5.1) or scree (4.3), at altitudes from 530–930 m on gentle to steep slopes (1°–40°), all aspects; TMS of the Peninsula Formation (C1Q1) except relevé 140 (Nardouw Formation, C1Q2); substrate of silty sand 0–60 cm deep with some organic matter, stones and boulders, soil well drained but moist because of either the phreatic situation or percolation beneath the scree; litter cover 10–55%, usually over broken bedrock (95% exposed) or, on the decomposed screes, covered by deeper soil with only 10–30% protruding rock. Annual rainfall 500–900 mm, generally around 650 mm.

Special features: the absence of diagnostic species exclusive to this community and the wide range in its environmental influences and habitats, indicates its transitional nature between the river thickets and those of scree and sand.

Community 4 *Olea europaea* subsp. *africana*–*Myrsine africana* Community on sandy flats and xeric screes (Figure 8)

Structural category: low forest

Relevés: (12) 9, 10, 11, 12, 13, 67, 80, 92, 135, 159, 160 & 184

Species richness: 23 (16–32)

Species group (Appendix 2): E

Vegetation: mature; cover 70–100%, usually over 95%. There are three strata, the upper of trees to 6.5 m tall, the intermediate of forest shrubs to 2 m, and the lower stratum of sub-shrubs, e.g. *Myrsine africana*, and herbs (*Stachys aethiopica*) usually less than 1 m in height. Ground mosses and rock lichens could be considered an additional layer of negligible height. The woody climber *Secamone alpini* commonly ascends to the tops of the trees.

Dominants: in the tree layer, *Olea europaea* subsp. *africana* with 100% presence and cover up to 50%, and *Heeria argentea*; less frequently *Cassine peragua* and *Maytenus oleoides*, and occasionally *Podocarpus elongatus* and *Kiggelaria africana*; in the intermediate layer *Hartogiella schinoides* and *Rhus undulata*.

Locality and environment: occurs in the Pakhuis area both north and south of the pass, usually along the edge of sandy flats adjoining the steep-cliffed 'boulder koppies' on their shady side, less commonly on xeric screes (land facets 2.1 or 4.3); level or almost level terrain on the flats but, on screes, sloping up to 35° with a southwesterly aspect; altitude 600–1 000 m; on TMS of Peninsula (CIQ1) and Nardouw (CIQ2) Formations; substrate always well drained, of white sand up to 60 cm deep on the flats, sometimes with rock at or close to the surface, especially on screes; rock cover 0–99%, litter cover 15–95%, not much decomposed. Rainfall from 300 mm at the lowest altitude to 600 mm at the highest.

Special features: diagnostic species for this community are not found in the tree canopy but in the lower strata, e.g. *Euclea lancea* in the tall shrub layer, *Euclea acutifolia*, *Anisodonteia bryoniifolia* and *Stachys linearis* in the undershrub layer. These are species chiefly of drier regions (Namaqualand and Karoo) and are unlikely to be found in thickets further south. *Rhus tomentosa*, on the other hand, is widespread in southern Africa and characteristically occurs on thicket margins throughout the Cape Floristic Region. *Myrsine africana* has high presence in the lower stratum but is not confined to thickets; it occurs sparingly in fynbos communities that have rather deep soil and canopies casting appreciable shade. Subcommunity 3a of Mustart *et al.* (1993) is synonymous with this community.

Relationship of the thicket Communities 1–4 to Campbell's (1985) Scheme: Community 1, with *Brabejum stellatifolium* dominant, shows close relationship to Campbell's Witrivier Closed-Scrub Fynbos, a community that has been formally recognized by previous workers. In Community 2, the similarity to Closed-Scrub decreases and elements of the non-fynbos Afromontane Forest (*Halleria lucida* and mesic ferns) are present. The forest element persists in Community 3 which, in addition, contains a strong suite of species of the non-fynbos thicket group, principally Mitchell Thicket, e.g. *Olea europaea* subsp. *africana* (shared with Cape Thicket), *Hartogiella schinoides* and *Heeria argentea*. Community 4 lacks forest species but retains the full thicket element which is further strengthened by a group of its own diagnostics, including some with typical northern dry-shrubland distribution such as *Euclea lancea*, *Anisodonteia bryoniifolia* and *Stachys linearis*. In structure, as in floristics, these communities intergrade.

B. FYNBOS OF WELL-DRAINED HABITATS (Communities 5–19)

These fynbos communities, occurring on both rocky and sandy sites at all altitudes, are characterized by the



FIGURE 8.—*Olea europaea* subsp. *africana*–*Myrsine africana* Community (No. 4) on sandy flat at Leipoldt's Grave, relevé 9. *Cassine peragua* dominant in upper canopy; *Heeria argentea* on rocks above.



FIGURE 9.—*Crassula atropurpurea*–*Aloe mitriformis* Community (No. 5) on Nardouw bedrock, summit of Pilaarberg, 1 000 m, relevé 141. *Aloe mitriformis* is conspicuous in centre. *Ehrharta calycina/villosa* and *Pentasthis eriostoma* dominate this relevé.

presence of one of the species in group AP (Appendix 2)—usually *Ehrharta calycina/villosa* but if not, then *Ischyrolepis sieberi*. Most communities of rocky habitats (Communities 5–16, rocky habitat group in Figure 5) are characterized by species in the *Ficinia nigrescens* group (AA, Appendix 2) but these are virtually absent in the high-altitude rock slope community (16) and in the sand communities (17–19, sandy habitat group in Figure 5).

1. Rocky habitats (Communities 5–16)

Virtually all the mountain slopes of the Cederberg fall into this category. Twelve communities are distinguished, some better defined than others. This rocky habitat group is floristically divided into three subgroups: Communities 5–12 defined by the presence of the *Passerina glomerata* species group (T, Appendix 2); Communities 13–15 characterized by the high presence and dominance of *Ischyrolepis gaudichaudiana*; Community 16 on high steep slopes forms a separate anomalous subgroup in which nearly all diagnostic species of well-drained rocky habitats are absent.

Communities 13–15 occupy lower mid-slopes strewn with rocks and boulders that have fallen from the cliffs above—here called the colluvial rock slopes (Harmse *et al.* 1984). This feature chiefly separates this subgroup from Communities 5–12 which occur on slopes and platforms where rockiness is due in greater measure to protruding bedrock than to surface debris.

1.1 Non-colluvial rock slopes and platforms (Communities 5–12)

The many different habitats occupied by this group are detailed in the text. Communities 5, 6 and 7 on bedrock platforms are clearly related to one another and may, in a formal classification, be mere variations of a single syntaxon. The relationship between communities 11 and 12 is less obvious; the latter, which has no diagnostics, may be merely a depauperate form of the former.

Community 5 *Crassula atropurpurea*–*Aloe mitriformis* Community on Nardouw bedrock platforms (Figure 9)

Structural category: low open shrubland with a graminoid-cyperoid-succulent understorey and mid-high emergent shrubs

Relevés: (7) 138, 141, 157, 173, 174, 175 & 176

Species richness: 28 (17–35)

Species group (Appendix 2): H

Vegetation: mature; cover generally 50–60% but can be below 25% in sites with much exposed bedrock; two strata, the upper to 1 m tall, of narrow-sclerophyllous shrubs, the lower to 0.6 m, hemicryptophytic (grasses, restioids and sedges) with succulents; emergent broad-leaved shrubs and low trees to 2 m.

Dominants: usually none, but species with high presence include: (1) upper stratum: the shrubs *Passerina glomerata*, *Eriocephalus africanus*, *Diosma acmaeophylla*, *Protasparagus suaveolens*; (2) lower stratum: *Ehrharta calycina/villosa*, *Pentasthis eriostoma*, *Ficinia nigrescens* and succulents, especially *Crassula dejecta* and *Ruschia dichroa*; (3) emergents: *Protea glabra* and the dwarfed low tree *Heeria argentea*.

Locality and environment: mainly north of Pakhuis Pass, with one outlier east and another far south (Heuningvlei); on bedrock strata (land facet 1.2) level or sloping 5°–15° NW to NE at 900–1 000 m altitude (except Heuningvlei 700 m); TMS of Nardouw Formation (C1Q2) except the two outliers on the upper edge of the Peninsula Formation (C1Q1); substrate of very shallow (5 cm) coarse quartzitic sand, pebbles and stones, seldom with organic content or much litter (<10%), over bedrock 50–99% exposed. Annual rainfall ± 500 mm.

Special features: this is a harsh habitat. Bare rock covers at least half the surface. The shallow soil, usually dry and hot, is subject to seasonal extremes of moisture and temperature—briefly flooded after rain, frosty on cold winter

mornings. To these conditions the vegetation has responded with a diversity of xerophytic life forms—aphylly with green stems, sclerophylly, succulence and summer leaf-shedding.

Individual stands are usually small in extent, sometimes scarcely larger than the sample plot, like islands in a sea of rock, but the flora is quite rich: more than half the relevés have 31–35 species each. These include the rare *Agathosma distans*, the endemic *Schlechteria capensis* and several small recondite plants only conspicuous when briefly in flower, for example *Conophytum minusculum* (succulent), *Felicia cymbalariae* (annual) and *Lachenalia elegans* (geophyte). Crustose and foliose lichens thickly cover the open rock surfaces. The lanky emergent *Protea glabra* and the coarse wiry tangles of *Restio perplexus* are good indicators of this and the following community. Communities 5 & 6 also share with some thickets the species of Group K that can survive in dry sites wherever a large proportion of open rock provides some protection from fire.

Community 6 *Crassula atropurpurea*–*Lampranthus cedarbergensis* Community on Peninsula bedrock platforms (Figure 10)

Structural category: low open shrubland

Relevés: (8) 53, 68, 69, 71, 75, 79, 83 & 96

Species richness: 27 (22–30)

Species group (Appendix 2): I

Vegetation: mature; cover about 55%, less variable than Community 5; strata usually two but less distinct than in Community 5, the upper 50–200 cm, of both narrow- and broad-leaved sclerophyllous shrubs and occasionally a tall restioid; the lower usually below 50 cm, of narrow-sclerophyllous shrubs with hemicryptophytes and succulents, the two last-named sometimes distinguishable as a separate understorey.

Dominants: *Diosma acmaeophylla* usually in the upper stratum, *Restio perplexus* in the lower. Non-dominant

species with high presence include the nanophyllous shrubs *Rhus rimosa* and *Phyllica oleifolia* in the upper stratum, *Ehrharta calycina/villosa*, *Ficinia nigrescens*, *Lampranthus lunulatus*, *Crassula atropurpurea*, *Passerina glomerata* and *Stoebe intricata* in the lower.

Locality and environment: found on small rock platforms in the broken country of Pakhuis Pass between the Kliphuis and Taaiboskraal Rivers, especially along the jeep track between Leipoldt's Grave and Amon se Poort but also on isolated sites further south; on bedrock strata (land facet 1.2, sometimes as saucer-like depressions) level or sloping 2°–10° NW to NE at about 800–1 000 m altitude; TMS of Peninsula Formation (C1Q1); substrate less than 10 cm of sand, pebbles and stones, the sand pinkish on the surface, yellowish grey to brown below; negligible organic matter but undecomposed litter 10–30% over bedrock up to 98% exposed. Annual rainfall averages 700 mm.

Special features: habitat similar to Community 5; vegetation structure also similar but cover more uniform and stratification less distinct. Relevés have no more than 30 species and lack the rare and special species of Community 5. *Stoebe intricata* and *Aspalathus polycephala* are more prevalent and characteristic. *Cannomois taylorii*, a tall rhizomatous restioid in the upper stratum, forms quite large stands on bedrock at low altitudes but was only recorded in relevé 79.

Community 7 *Restio perplexus*–*Macrostylis squarrosa* Community on Peninsula bedrock outcrops

Structural category: low open shrubland

Relevés: (4) 4, 5, 6 & 48

Species richness: 28 (20–34)

Species group (Appendix 2): L

Vegetation: mature; cover 50–80%; basically one stratum of leptosclerophyll shrubs to 1 m, a lower graminoid-restioid element present to varying degrees but lacking the



FIGURE 10.—*Crassula atropurpurea*–*Lampranthus cedarbergensis* Community (No. 6) on Peninsula bedrock near Pakhuis Pass, 780 m, relevé 79. The tall, dark, erect restioid is *Cannomois taylorii*.



FIGURE 11.—*Ischyrolepis capensis*–*Elytropappus rhinocerotis* Community (No. 8) on Pakhuis Pass at 870 m, relevé 91. *Metalsia densa* with white flower heads in foreground, *Elytropappus rhinocerotis* beyond. *Protea nitida*, 2 m, on right. Below road, vegetation becomes mixed. Rocky area, left distance, is the Peninsula Bedrock Community (No. 6).

succulents of Communities 5 and 6; sometimes with shrubs emergent to 2 m but the broad-sclerophyllous shrub/tree element absent.

Dominants: *Stoebe intricata*, *Ischyrolepis sieberi*, sometimes *Merxmuellera arundinacea*, but none are invariably dominant or even present.

Locality and environment: occurs towards the western edge of Community 6 (Figure 3) and in the same general habitat, at altitudes below 900 m, on small bedrock outcrops that are not, as in Community 6, raised above the general level of the landscape but are contiguous with the sandflats Community 18 (land facet 2.1) and therefore likely to be more fire-prone than the foregoing communities.

Special features: the locally strong dominance of *Stoebe intricata* which appears to be a 'fire-weed' like *Stoebe plumosa* (also present in this community), and absence of all members of the broad-sclerophyllous shrub/tree element, suggest that Community 7 is a variation of Community 6 that has become degraded through too frequent burning.

Relationship of the bedrock Communities 5–7 to Campbell's (1985) scheme: by reason of their overstorey of microphyllous and nanophyllous shrubs, Communities 5 and 6 may be classified as a xeric variation of Campbell's Oukraal Oligotrophic Asteraceous Fynbos. The greater aridity in the far northern part of the Cederberg where these communities are found, and the shallower soil there, may explain the shorter, sparser overstorey compared to Campbell's Oukraal sites. Community 7 appears to represent a degraded condition of the same structural type, Oukraal, and is roughly synonymous with the subcommunity 2a described by Mustart *et al.* (1993).

Community 8 *Ischyrolepis capensis*–*Elytropappus rhinocerotis* Community of the Pakhuis shaleband (Figure 11)

Structural category: low mid-dense to closed small-leaved shrubland

Relevés: (13) 84, 85, 86, 87, 88, 89, 90, 91, 93, 94, 95, 142 & 144

Species richness: 29 (16–43)

Species group (Appendix 2): 0

Vegetation: mature, total cover 73–99%; one or two strata, the upper sparse to open leptosclerophyllous or proteoid shrubs to 2 m, the lower mid-dense or closed to 1 m, with leptosclerophyllous-spinescent and cupressoid-leaved shrubs and graminoid-restioid herbaceous plants; or if a single stratum, all forms excluding proteoid, to 1 m. The large number of diagnostic species, most of which are exclusive (*sensu* Braun-Blanquet 1932), are shown in Appendix 2. Species preferential to this community (Braun-Blanquet 1932) are the restioid *Ischyrolepis capensis*, the grass *Lasiachloa longifolia* and the small-leaved shrub *Agathosma capensis* in the lower layer and *Dodonaea angustifolia* usually in the upper layer.

Dominants: first and foremost the exclusive diagnostic and very characteristic *Elytropappus rhinocerotis*—the grey, cupressoid-leaved 'renosterbos'—as well as *Metalsia densa* (spinescent leptosclerophyllous), *Helichrysum dasyanthum* (lepto-orthophyllous) and, on two sandy transitional relevés, the tall restioid *Willdenowia incurvata*.

Locality and environment: strictly confined to the shaleband traversed by Pakhuis Pass and its outlier to the south at Groenberg; on the step, 'trap' or inclined ledge of the detrital (upper pediment) slope (4.1) or the steeper talus slope (4.2) or, in the case of relevé 93, the convexo-concave slope (5.2) near the base of the mountain; altitude 860–1 000 m, sloping 6°–28° on aspects predominantly west through south to east; confined to the Cedarberg Formation (C1S2G); substrate of fine yellow-brown silt with higher nutrient status than TMS soils, up to or exceeding 50 cm in depth with some surface sand, gravel and

stone above the undecomposed clayey shale; litter cover variable (1–60%), broken rock 0–10% or at most 20%. Annual rainfall 400–500 mm on the Pass, 800 mm at Groenberg in the south.

Special features: the shaleband is easily recognized because it forms a distinct break in the general slope, less steep and clothed with a vegetation of finer texture and greyer colour than most fynbos due to the strong dominance of the renosterbos, *Elytropappus rhinocerotis*. Other features of the community are the large suite of species exclusive to it (already mentioned) and the high cover and diversity of the graminoid element. The latter accords with Campbell's (1986b) findings that grass cover is high on the finer-textured soils. The grasses in the Pakhuis renosterveld are quite frequently grazed, probably by rodents as well as small antelope.

Relationship of the Pakhuis shaleband Community 8 to Campbell's (1985) scheme: two relevés (89 and 93) with more than 50% cover of *Elytropappus rhinocerotis* are possibly Renoster Shrubland, and a further three on dry sites at low altitude, where *Protea arborea* is lacking, may be Clanwilliam Karroid Shrubland. The remaining eight relevés, having *P. arborea* within or near their boundaries, conform closely to Campbell's Gydo Talus Asteraceous Fynbos, a type occurring on fine-textured soil. Despite its uncertain structural identity, Community 8 is clearly a cohesive, well-defined floristic unit in view of its very strong suite of 16 exclusive species. Moreover, it is confined to a distinctive habitat which, in practical terms, would be a single management unit.

Community 9 *Protea laurifolia*–*Euryops speciosissimus* Community on the Welbedacht footslopes

Structural category: tall mid-dense proteoid shrubland with a mid-high, mid-dense shrub understorey

Relevés: (3) 26, 31 & 32

Species richness: 31 (28–33)

Species group (Appendix 2): nil

Vegetation: young-mature to senescent; relevé 31, considered mature and typical, has 95% total cover in three strata, the upper 2–4 m tall, proteoid, the middle 1.0–1.5 m narrow-sclerophyllous shrubs, the lower less than 0.5 m of graminoids, restioids, sedges and low nanosclerophyllous shrubs.

Dominants: *Protea laurifolia* in the upper stratum, *Phyllea rigidifolia* and *Cliffortia ruscifolia* in the middle, *Ischyrolepis gaudichaudiana* in the lower. This community has no differentials but species with high presence include *Euryops speciosissimus*, *Eriocephalus africanus*, *Oedera squarrosa* and *Gnidia geminiflora*.

Locality and environment: limited in the present survey to the lower pediment slopes (6) of the Welbedacht escarpment at an altitude of 920–950 m, sloping gently W to SW on Peninsula Formation (CIQ1); substrate about 20 cm deep of medium fine reddish brown sand with pebbles and

stones, sometimes with small patches of exposed bedrock; rock cover 5–25%; litter cover 85% but less in the younger vegetation. Annual rainfall \pm 650 mm.

Special features: this is one of the few communities within the State Forest that show signs of biotic disturbance. Baboons have broken protea branches to reach the edible seeds and insects within the flower heads; proteas are still being felled for firewood; and local senescence that is a feature of these footslopes may be the result of patchy burning in the past.

This tall proteoid community is rare within the Mountain Catchment Area but more common in comparable habitats outside it. This may be partly due to the fact that the habitat itself is more widespread on the drier plains and slopes outside the MCA, but it is also likely that the repeated management burns in the State Forest have hitherto been carried out predominantly in winter or spring, thus reducing the tall proteoid seedling recruitment within the reserve (Van Wilgen & Viviers 1985).

Relationship of the Protea laurifolia Community 9 to Campbell's (1985) scheme: Campbell records only two types of Proteoid Fynbos from the northwestern mountains, Weltevrede and Hawequas Dry Proteoid Fynbos, and Community 9 agrees most closely with the Hawequas type. It seems likely that some stands of *P. laurifolia* mentioned in 'Special features' (above) as being more common outside the catchment, could belong to the Weltevrede type, for example in the Eselbank area where there is more shale.

Community 10 *Ischyrolepis sieberi*–*Dolichothrix ericoides* Community on bedrock summit plateaux above 1 200 m altitude

Structural category: low mid-dense restioid shrubland

Relevés: (3) 50, 52 & 148

Species richness: 19 (17–20)

Species group (Appendix 2): R

Vegetation: mature with only 50–65% total cover; single stratum 0.5–0.8 m of dominant restioids with narrow-sclerophyllous shrubs and succulents; occasionally with sparse emergent shrubs to 1.5 m.

Dominants: *Ischyrolepis sieberi* in all three relevés, *I. curviramis* in two, *I. virgea* in one.

Among the differential species the succulent form predominates: *Mesem 11672* is exclusive to the community, *Lampranthus lunulatus* and *Senecio crassulifolius* are preferential, being present also in the lower bedrock communities, Communities 5 and 6. *Dolichothrix ericoides* (= *Helichrysun ericoides*) is an easily recognizable wiry, cupressoid-leaved subshrub growing in cracks of bare rock outcrops. The only constantly present shrub (weakly preferential) is *Oedera sedifolia* which, again, is present in the lower bedrock communities. Crustose lichens are abundant at high altitude.

nual rainfall 800–1 400 mm—the latter on Krakadou summit at 1 700 m altitude.

Special features: though variable in composition this community shows some floristic affinity and habitat similarity with the lower bedrock communities 5, 6 and 7. At its lower altitudinal range on the Groenberg plateau it is within the habitat of the cedar community (11) and relevé 52 contains a stunted cedar 1.5 m tall. Since the community is undersampled, it is difficult to generalize about its characteristic features.

Community 11 *Stoebe aethiopica*–*Widdringtonia cedarbergensis* Community of the upper mid-rock slopes ('sederveld' or cedar woodland: Figures 12, 13 and Frontispiece)

Structural category: open woodland with mid-dense restioid understorey; or low to mid-high, mid-dense restioid shrubland.

Relevés: (20) 33, 37, 38, 39, 40, 41, 47, 101, 103, 107, 111, 112, 113, 116, 119, 125, 137, 152, 177 & 178.

Species richness: (24) 16–37

Species group (Appendix 2): S

Vegetation: mainly mature; cover (45)–55–85%. The best-developed woodland has three strata, the upper of the cupressoid-leaved tree *Widdringtonia cedarbergensis* to 8 m, the middle of mid-high shrubs and restioids 1–2 m, the lower of hemicytophytes, predominantly restioid, 0.5–1.0 m. The shrubland has two strata, sometimes scarcely distinguishable, similar to the middle and lower strata of the woodland.

Dominants: the differential *W. cedarbergensis* in the tree layer when present, *Passerina glomerata* occasionally in the shrub layer, and *Ischyrolepis ocreata*, *I. sieberi* and *I. gaudichaudiana* in the ground layer. Most relevés contain one or both of the foremost differentials, *W. cedarbergensis* and *Stoebe aethiopica*.



FIGURE 12.—*Stoebe aethiopica*–*Widdringtonia cedarbergensis* Community (No. 11) above Donkerkloof, Welbedacht, \pm 1 400 m. In this woodland variation middle stratum of mid-high shrubs lacking. Standing erect against rock to right of figure is a sawn cedar plank rejected by woodcutters of earlier times.

Locality and environment: occurs from Krakadou northwards on level bedrock summit plateaux (1.2) from 1 200–1 700 m in altitude; Peninsula Formation (C1Q1) with, at most, 10 cm of coarse sand and gravel over bedrock with cover of 40–95%; 10–20% litter cover. An-



FIGURE 13.—A grove of cedars (Community No. 11) on edge of Welbedacht Shaleband. Shrubland in foreground, with *Ischyrolepis virgea* and *Protea acuminata*, is part of the shale community (No. 17).



FIGURE 14.—*Ischyrolepis sieberi*-*Passerina glomerata* Community (No. 12) on the Groenberg plateau at 1 350 m, relevé 63, with *Ischyrolepis virgea* and *Cannomois parviflora* dominant, young *Protea magnifica* plants conspicuous.

Locality and environment: occurs chiefly in the Welbedacht area, decreasing northwards to the Pakhuis Mountains, in broken rocky country, on local ledges (1.2) or upper pediment slopes (4.1) above the steep cliff zone, at altitudes usually between 1 000 and 1 500 m. All aspects on slopes from level to 40° (mainly 0°–20°) on both Peninsula (C1Q1) and in the north above the shaleband on Nardouw (C1Q2) Formations, on a substrate of coarse sand, gravel and stones over bedrock. Rock cover 8–99% but usually less than 50%; litter 5–45% but usually less than 15%. Annual rainfall from 500 mm at low altitudes to 1 400 mm at the highest.

Special features: floristically this is a variable and weakly cohesive assemblage of relevés which is difficult to characterize because neither the dominants nor the differentials are strongly present. The woodland is of course easy to recognize by the presence of the cedar tree. Attempts to segregate the non-cedar relevés as a distinct community proved unsatisfactory. The total assemblage can best be defined by environmental parameters: it is the habitat within an altitudinal range of 1 000 to 1 500 m which does or could support the cedar. In past times this useful tree has been rapaciously felled, and increasingly frequent wildfires have decimated the natural regeneration. Much of the restioid shrubland in this upper mid-mountain zone may be degraded woodland from which the cedars have been removed. Also, at upper limits of its habitat the cedar is so naturally scarce that few relevés at high altitudes contain it.

Community 12 *Ischyrolepis sieberi*-*Passerina glomerata* Community of Groenberg Plateau (Figure 14)

Structural category: low closed restioid shrubland

Relevés: (4) 57, 58, 62 & 63

Species richness: (22) 20–28

Species group (Appendix 2): nil

Vegetation: mature; cover (50)–90–95%; single stratum to 0.9 m of mainly restioid hemicryptophytes with leptosclerophyllous and cupressoid-leaved shrubs, occasionally with open proteoids (*Protea magnifica*).

Dominants: only the restioids *Cannomois parviflora*, *Ischyrolepis sieberi*, *I. virgea* and *Restio filiformis*, and locally the widespread shrub *Stoebe plumosa*. There are no differentials and the only species with 100% presence, besides some of the dominants, are the common ubiquists of mountain fynbos, *Metaliasia densa* and *Cliffortia ruscifolia*. *Pteronia canthorata*, with 75% presence but low cover, is more constant in this community than in any other.

Locality and environment: this community is limited to one locality, the broad table-top of the mountain block north of Krakadou which I have called the Groenberg plateau. It occurs on local level terraces, platforms and ledges (1.2) of the Peninsula Formation (C1Q1) on the top of this plateau (1 260–1 360 m in altitude), in coarse white sand with some surface pebbles, stones and rock over sheet or broken rock at a depth of 10–20 cm. Surface rock cover varies from 0 to 95%, litter cover from 5 to 50%. Annual rainfall 800 mm.

Special features: like the foregoing, this is a variable and poorly defined community. Its logical position in Figure 5 and Appendix 2, adjacent to the cedar community, as well as its habitat at the upper limit of the cedar zone on this plateau, indicates that it is a depauperate form of the cedar community. In floristics and habitat, however, it also shows some affinity with the high-altitude bedrock community 10 on the one hand, and those of level sandy flats (Communities 17–19) on the other. In short, it represents a complex transitional situation.

Relationship of the cedar group Communities 10–12 to Campbell's (1985) scheme: attempts to identify the structural category of the cedar community (11) with my inade-

quate structural data point to three possible types in Campbell's system: Winterhoek Dry Restioid Fynbos, Algeria Oligotrophic Asteraceous Fynbos and Wuppertal Oligotrophic Asteraceous Fynbos. The latter, having Ericaceae as well as Proteaceae present, seems the most appropriate fit. Campbell, interestingly, made no mention of a cedar woodland in his description of the Wuppertal type or any other category in his classification, implying, perhaps, that the understorey was all-important for structural classification and the cedar overstorey was irrelevant. In my floristic classification I reached the same conclusion with the finding that the non-cedar relevés could not be segregated as a separate community.

Communities 10 and 12 seem closer to each other than either of them is to Community 11. In addition to the common restioids and leptophyllous shrubs, Community 10, on a shallow, stony substrate, has some low succulent components whereas in Community 12, on deeper soil, two seed-regenerating proteoids (*P. magnifica* and *P. repens*) occur. In Campbell's scheme both communities are Restioid Fynbos. Community 12, with proteoids, is likely to be Winterhoek Dry Restioid Fynbos, and in view of other structural features that are common to Communities 10 and 12, both may well be different phases of the same structural type.

1.2 Colluvial rock slopes (Communities 13–15)

Community 13 *Protea nitida*–*Cliffortia hexandra* community on Nardouw talus slopes (Nardouw Waboomveld: Figure 15)

Structural category: low closed restioid shrubland with a tall open proteoid overstorey

Relevés: (3) 129, 131 & 132

Species richness: 53 (51–56)

Species group (Appendix 2): U

Vegetation: young-mature after a burn some seven years before; cover 90–95%; two strata, the upper an overstorey (3.5 m) of the tall proteoid *Protea nitida* and occasionally *Leucadendron rubrum*, the lower stratum (0.7–0.9 m) dominated by restioids but containing a rich variety of shrubs and herbs of many forms. Occasionally there is an intermediate stratum of ericoid shrubs \pm 1.0–1.5 m tall. Floristically this is the richest community recorded in the northern Cederberg.

Dominants: only *Protea nitida* in the overstorey, *Ischyrolepis gaudichaudiana* in the lower layer.

Locality and environment: this local variation of waboomveld has only been recorded on the Nardouw Formation (C1Q2) north of Pakhuis Pass. The three relevés were taken at the base of the highest peaks, Ribboksberg and Pakhuis Peak, at an altitude of about 980 m on steepish (25°) talus slopes (4.2) with a southwesterly aspect. The substrate is a fine loamy sand with gravel, stones and large colluvial boulders, with a measurable depth of 35 to 50 cm but probably deeper in places, well drained but comparatively moister than most slopes in the area; rock cover 90 to 98% but litter less than 10%. Annual rainfall 500 mm. Outliers of waboomveld further along this range and along the lower range above the shaleband are no doubt the same community but need to be sampled.

Special features: the remarkably species-rich Nardouw waboomveld, physiognomically so similar to Community 14, differs floristically from it by the large number of its almost exclusive differentials and the complete absence of the differentials of Community 14. More sampling is needed in Community 13 to determine its extent and its exact relationship to Community 14.

Community 14 *Protea nitida*–*Cheilanthes induta* Community on Peninsula talus slopes (Peninsula Waboomveld)



FIGURE 15.—*Protea nitida*–*Cliffortia hexandra* Community (No. 13) on a Nardouw talus slope at foot of Pakhuis Peak at 980 m. *P. nitida* forms the open overstorey; *Ischyrolepis gaudichaudiana* dominant in lower stratum. Relevé 131, with 56 spp., is the richest recorded in the survey.

Structural category: low mid-dense restioid shrubland with a tall sparse proteoid overstorey

Relevés: (15) 22, 24, 25, 27, 28, 29, 34, 35, 43, 46, 49, 54, 145, 146 & 154.

Species richness: 37 (27–47)

Species group (Appendix 2): V

Vegetation: mostly young-mature (approximately 7–10 years post-burn); cover usually 45–90%. There are two strata. Sometimes *Protea nitida* appears in the upper stratum together with the mid-high to tall shrubs *Lobostemon glaucophyllus* frequent, *Hypocalyptus sophoroides*, *Cliffortia ruscifolia* and a few others local or occasional, but in half the relevés *P. nitida* occurs alone in a sparse overstorey 2–6 m tall. The lower, densest stratum, less than 1 m, contains restioids (principally *Ischyrolepis gaudichaudiana*), grasses (e.g. *Ehrharta calycina/villosa*, *E. ramosa*), the sedge *Ficinia nigrescens* and a large variety of shrubs including *Clutia alaternoides* and *Stoebe plumosa* with 100% presence, and some less common plants with larger fleshy leaves, e.g. *Pelargonium laevigatum* and the summer-deciduous *Montinia caryophyllacea*. *Rhus rosmarinifolia*, a low woody shrub that is a frequent component of proteoid fynbos in the southwestern mountains, is rare in this community. The semiscandent woody shrub *Protasparagus compactus* is differential for the two Cedarberg waboomveld communities (13 & 14) and has high presence in both.

Dominants: *Ischyrolepis gaudichaudiana* constant and usually dominant in the lower layer, occasionally *I. sieberi*, *Elytropappus adpressus* and *Stoebe plumosa* either codominant with or replacing it. *Protea nitida*, though conspicuous in the upper layer, is not dominant except very locally where it affects community composition beneath large individuals.

Locality and environment: sixty percent of the relevés are in the Welbedacht area, on fairly uniform slopes of the colluvial boulder zone below the shaleband and the broken line of krantzes where the cedars grow. The remainder of the relevés are on slopes above Heuningvlei, with two outliers further north, one on either side of the Groenberg plateau. The community is confined to the Peninsula sandstone (C1Q1) talus (4.2) or occasionally the detrital slope (4.1), moderate to steep (16°–30°) with predominantly SW to SE aspects at altitudes of 1 000–1 200 m (the two northern outliers at 700 m and 870 m respectively). The soil, 10–40 cm deep, is generally a light grey or buff fine sand with angular quartz pebbles on the surface, darker grey and humic below, with many stones and scattered large boulders; rock cover 20–90% (average 50%), litter 3–30%. Annual rainfall 600–900 mm (average 760 mm).

Special features: black termite mounds 0.4–0.5 m tall are quite common in this community. Appendix 2 and the foregoing descriptions show that the two waboomveld communities are closely related.

Relationship of the Waboomveld Communities 13 & 14 to Campbell's (1985) scheme: since both Waboomveld Com-

munities have an overstorey of *Protea nitida*, they fall readily into Campbell's Talus Asteraceous Fynbos. Community 13 (Nardouw Waboomveld) shows greatest resemblance to Campbell's Brandwag Talus Asteraceous Fynbos. The high restioid cover, the presence of *Leucadendron rubrum* and the large suite of understorey species (many of them listed by Campbell) indicate the strong similarity.

Community 14 (Peninsula Waboomveld) probably equates with Uitkyk Talus Asteraceous Fynbos by reason of the taller restioids, the presence of ferns, the less diverse understorey and the more mesic habitat.

Community 15 *Ischyrolepis gaudichaudiana*–*Stoebe plumosa* Community of upper colluvial slopes (Figure 16)

Structural category: low mid-dense restioid shrubland

Relevés: (4) 102, 104, 164 & 168

Species richness: 18 (14–19)

Species group (Appendix 2): nil

Vegetation: mature (except for relevé 164: \pm five years post-burn); total cover 60–85%; one stratum, up to 1 m tall, the restioids contributing more cover than the shrubs which are also lower in stature. The restioids, except for *Ischyrolepis gaudichaudiana*, are tufted, stout and erect, the shrubs small-leaved or cupressoid. The hemicryptophytes include a few sedges (*Ficinia*, *Tetraria*) and grasses (*Ehrharta ramosa*). Proteoids absent.

Dominants: the restioids *Cannomois parviflora*, *Ischyrolepis sieberi* and *Hypodiscus laevigatus* are locally dominant; the shrub *Stoebe plumosa* regularly codominant.

Locality and environment: relevés were concentrated on the talus slopes (4.2) of Groot and Middel-Krakadou Peaks abutting the Groothoek Plateau above Heuningvlei at 1 150–1 250 m; aspect E, slope generally 25° (except relevé 104, NNW, 8°); Peninsula Formation (C1Q1) substrate of white to grey shallow sand (10 cm deep or less) with pebbles, very many stones and scattered large emergent boulders which reduce the total vegetation cover; rock cover 60–98%, usually over 90%, litter cover 0–25%. Annual rainfall 800–1 100 mm.

Special features: in floristics and habitat this community is evidently a transition on the gradient from the colluvial mid-slopes to the high summits. The soil on these slopes near the upper limit of colluvial debris is too shallow to support the rich association of species in the waboom communities, and the increased altitude contributes to a harsher climate, so that by reason of its decreased species richness this community is coming to resemble the species-poor restioid community of the highest altitudes.



FIGURE 16.—*Ischyrolepis gaudichaudiana*–*Stoebe plumosa* Community (No. 15) on upper colluvial slopes of Middel-Krakadou at 1 200 m, relevé 102. *Hypodiscus laevigatus* is dominant restioid; grey cypressoid-leaved shrub is *Stoebe plumosa*.

1.3 High-altitude rock slopes (Community 16)

Community 16 *Ehrharta ramosa*–*Tetraria triangularis* Community on high-altitude rock slopes

Structural category: mid-dense restioidland with low sparse shrubs

Relevés: (5) 45, 147, 162, 166 & 169

Species richness: 8 (7–10)

Species group (Appendix 2): AD

Vegetation: mature; average cover 68% (48–85%); one stratum up to 1 m tall, predominantly hemicryptophytic, the restioids dominating, the shrubs contributing not more than 25% cover. The restioids are stout and tufted, the shrubs narrow-leaved, usually of lower stature and inconspicuous except for the occasional occurrence of *Protea magnifica*, a high-altitude mesophyll.

Dominants: the restioids *Ischyrolepis sieberi*, *I. virgea* and *Cannomois parviflora*, usually one species dominating each relevé.

Locality and environment: this community has been recorded on the Krakadou range and its extension southward as far as Crevasse Peak; it probably occurs further south but the 1985 fire prevented sampling there. It is most often found on the waxing slope (3.2) near the summit ridge on the eastern side of the range, except for the rather atypical relevé 169 on the small flat subsummit plateau (1.2) of Middle Krakadou peak. Altitude is 1 600–1 700 m, aspect N to E, slope 0°–35°, generally about 20°; on Peninsula Formation (C1Q1), the substrate of shallow (less than 15 cm) coarse sand and/or angular quartz fragments with scattered surface stone or broken rock, sometimes massive blocks on bedrock. Rock cover 60–90% except for the sandy rock-free relevé 169; litter cover 15–35%. Annual rainfall 1 200–1 400 mm.

Special features: this community has the lowest number of species of any on the well-drained sites—8 spp./100 m². When other factors are not limiting, there is a decrease in the number of species on the gradient from low to high altitude. In the increasingly extreme environment as one ascends, species with narrower tolerances drop out, leaving the hardy species which may become sporadic in occurrence. The few specialized species that are added to the vegetation at high altitudes are local or rare and seldom compensate for the loss in richness. For this reason it is difficult to find constant diagnostic species for high-altitude communities. Both the diagnostics of Community 16 are specialists that demonstrate this phenomenon: they are exclusive to the community but occur with low presence. *Tetraria triangularis* is fairly widespread in high-altitude and/or high-rainfall mountain fynbos but is not common. *Agathosma stilbeoides* is endemic to the Cederberg where it is confined to the uppermost rocky slopes.

2. Sandy habitats (Communities 17–19)

Community 17 *Elytropappus adpressus*–*Leucadendron glaberrimum* Community of the Welbedacht shale-band (Figures 17 & 18)

Structural category: low closed restioid shrubland with or without a mid-high shrub overstorey

Relevés: (13) 30, 42, 108, 109, 110, 114, 115, 117, 118, 120, 121, 122 & 123.

Species richness: 24 (12–36)

Species group (Appendix 2): AF

Vegetation: mature, occasionally young-mature; cover 70–99% (average 91%); structure variable. Strata basically two but sometimes there is an additional overstorey or, less often, only the lower stratum is present. The overstorey, present in 40% of the relevés, consists of either



FIGURE 17.—*Elytropappus adpressus*–*Leucadendron glaberrimum* Community (No. 17) on Welbedacht shaleband below Corridor Peak at 1 350 m, relevé 30. *Protea acuminata* dominant in overstorey. Note the talus from Nardouw cliffs above and bare lower edge of shaleband in foreground.

mid-high open or sparse proteoid shrubs (*Protea acuminata*, *Leucadendron pubescens*, *L. dubium*) or the emergent restioid *Cannomois virgata* in relevé 121. The upper stratum is sparse or open, seldom exceeds 1 m in height, and has a mixture of hemicryptophytes and shrubs, the latter predominant, comprising proteoid (*Leucadendron glaberrimum*) and narrow-leaved forms (*Athanasia microphylla*) or stiffly tufted restioids, e.g. *Cannomois aristata* and *Ischyrolepis virgea*. The lower stratum does not exceed 50 cm in height. Where it is closed it is strongly represented by restioids; where mid-dense, by the cupressoid-leaved shrub *Elytropappus adpressus*.

Dominants: among the shrubs are *E. adpressus* (fully constant but not exclusive), *Protea acuminata* and *Leucadendron glaberrimum* (proteoid), *Aspalathus triquetra* and *Metalasia densa* (leptosclerophyll). Usually only one of these assumes dominance in each relevé. Dominant restioids, mainly in the lower stratum, are *Ischyrolepis*

unispicata (creeping and rhizomatous), *Cannomois parviflora* and *Ischyrolepis virgea* (tufted), *Willdenowia arescens* and *Calopsis viminea*. In the few cases where only the lower closed restioid stratum is present, the structural category is closed restioidland.

Locality and environment: this community was sampled along the shaleband from Sneekop to Wolfberg, above the farms Welbedacht and Driehoek. Here the shaleband (Cedarberg Formation, C1S2G), a gently inclined ledge of the upper pediment slope (4.1), is sandwiched between the precipitous cliffs and steep talus of the Nardouw Sandstone above and the broken slopes of the Peninsula Sandstone below (Figure 18). The ten relevés on this formation are at about 1 200–1 500 m altitude on gentle S to SW slopes of 0°–10°. The remaining relevés (42, 117 and 123) are at 1 030–1 130 m altitude with similar aspect and slope on Peninsula formation (C1Q1) ‘sandflats islands’ and during the sampling were presumed to belong to the sand-



FIGURE 18.—General view of step-like Welbedacht shaleband (Community 17). Grasses predominate in the lighter vegetation above the track at 3 years post-burn. Broken rocky fallaway below shaleband marks upper level of cedar community (No. 11).



FIGURE 19.—*Willdenowia arescens*–*Thamnochortus platypteris* Community (No. 18) on a sandy flat near Heuningvlei at 1 000 m, relevé 156. *Thamnochortus platypteris* is the dominant restioid; white-flowered shrub in foreground is *Metasia agathosmoides*.

flats (Community 18). The soil generally is a fine silty pinkish to yellow sand, darker beneath, 15 cm to over 50 cm deep, with surface gravel and stones from the sandstone cliffs above; lacking organic material; litter cover 7–40%, usually 5–15%; rock cover 0–90% (average 18% but in 70% of the relevés 0–5%) mostly consisting of surface stone, the highest rock cover being on relevés close to the Nardouw Sandstone cliffs or outcrops. Annual rainfall 600–1 100 mm (average 923 mm but in 70% of the relevés 900–1 100 mm). The community appears to be more grazed and foraged than any other in the northern Cederberg: donkeys, klipbok, porcupines, grysbok, baobons, rodents and termites were noted.

Special features: structurally this community is by no means uniform, varying from a two-layered restioid shrubland with overstorey to a unistratal restioland with few shrubs resembling the structure of the restioid sandflats, Community 18. The local nature of the dominants and their diversity in form increases the impression of heterogeneity. On the other hand, floristic homogeneity is shown by the strongly differential nature of the diagnostic species, though only *Leucadendron glaberrimum* and *Athanasia microphylla* occur with reasonably high presence. *Elytropappus adpressus*, very characteristic and 100% present, is not diagnostic because it is also found in the waboom and cedar communities. Until now this species has been assumed to be conspecific with the renosterbos of the Pakhuis shaleband, *E. rhinocerotis*. *Willdenowia stokoei*, uncommon in the northern Cederberg, occurs infrequently in this community.

The Welbedacht shaleband community occurs on fertile soil with high rainfall and probably retains good sub-surface moisture during the dry season by reason of an underlying deep bedrock of sandstone. Perhaps on account of these factors and the abundance of grasses in the early post-burn stage (Figure 18), this shaleband vegetation has a denser plant cover and higher faunal utilization than

most other well-drained fynbos communities in the northern Cederberg.

Relationship of the Welbedacht shaleband Community 17 to Campbell's (1985) scheme: despite its uniform physiography, the Welbedacht shaleband below the peaks of Sneeuwkop, Langberg, Tafelberg and Wolfberg bears a complex pattern of vegetation. Nevertheless, all the relevés on this shaleband, and three on a narrower but similar band below it, sorted naturally into one homogeneous unit, Community 17.

Campbell also worked here and named his Langberg Azonal Restioid Fynbos after this shaleband. But only two of the 13 relevés in Community 17 (those with mat proteoids and over 10% grass cover) key to the Langberg type. Most of the others fit uncomfortably into either Winterhoek Dry Restioid (with *Elytropappus* and seed-regenerating proteoids) or Wolfberg Azonal Restioid (*Elytropappus* without proteoids). Campbell also acknowledged this complexity with the observation (p.78) that 'where there is much colluvial material the vegetation may be Dry Restioid Fynbos, but the most common type of shaleband vegetation of the interior mountains is Langberg Azonal Restioid Fynbos.'

This, like the Pakhuis shaleband (Community 8), is another example of a diversity of structural units in one well-defined floristic community which, on account of its physiographic uniformity, would form a single management unit.

Community 18 *Willdenowia arescens*–*Thamnochortus platypteris* Community of local sandy flats ('sandflats Community': Figure 19)

Structural category: closed restioland with a low shrub understorey, with or without a mid-high shrub overstorey or emergents.

Relevés: (23) 1, 2, 14, 15, 16, 18, 19, 66, 76, 77, 78, 81, 82, 99, 126, 133, 134, 136, 139, 143, 156, 171 & 172
Species richness: 22 (16–37)
Species group (Appendix 2): AI

Vegetation: young, mature or senescent; cover 55–97% (average 81%), in general a single stratum up to 1 m in height comprising hemicytrophites and shrubs, sometimes distinguished as a dominant restioid layer with an understorey of 200–400 mm shrubs. There may be a mid-high open shrub overstorey or sparse emergents to 2 m which increase in density with post-burn age. The hemicytrophites of the main stratum are mainly restioid, typically *Thamnochortus platypteris*, *Ischyrolepis monanthos* and *Willdenowia arescens*; however, the sedges *Tetraria compar*, *T. nigrovaginata* and *Ficinia bulbosa* are common, the grasses *Cymbopogon marginatus* and *Merxmüllera stricta* less frequent and *Stipagrostis zeyheri* rare. The shrubs of the main stratum are usually lower in stature than the hemicytrophites and of varied form, e.g. leptosclerophyllous (*Metasia agathosmoides*, *Stoebe leucocephala*, *Macrostylis tenuis/decipiens*), low-spreading fleshy-nanophyllous (*Rafnia diffusa*), leaf-succulent with woody stem (*Lampranthus laetus*), creeping proteoid (*Protea acaulos*) and chamaephyte (*Pelargonium coronopifolium*). Overstorey or emergent shrubs 1–2 m high include the sclerophylls *Cliffortia ruscifolia*, *Anthospermum aethiopicum*, *Aithanasia oligophylla*, proteoids *Leucadendron salignum* and *L. loranthifolium*, and locally the fleshy broad-microphyllous *Othonna parviflora*.

Dominants: restioids *Ischyrolepis monanthos*, *Thamnochortus platypteris*, *Willdenowia arescens*, *W. incurvata*, *Ischyrolepis sieberi*, *Cannomois parviflora* and rarely *Hypodiscus neesii*; among the shrubs *Rafnia diffusa*, *Metasia agathosmoides*, rarely *Cliffortia ruscifolia* and *Diosma meyeriana*.

Locality and environment: local sandflats are found most frequently in the broken country south of Pakhuis Pass from Klein Kliphuis to the top of the pass and in the north between the peaks of the Pakhuis range (Figure 3). They occur less frequently on the eastern slopes skirting the Groenberg plateau and the Krakadour range. These local flat plains (2.1) give the appearance of terraces where they are surrounded by low rock outcrops or ridges, as in the broken terrain south of Pakhuis Pass, or of corridors between high cliffs in the northern and southern ranges. They occur on sandstones both of the Nardouw (C1Q2) and Peninsula (C1Q1) Formations, on level or gently inclined sites (0°–6°) mainly N to ENE in aspect at altitudes of 700–1 100 m. The substrate is white sand, at many sites estimated to be more than 1 m deep and very well drained, sometimes with quartz pebbles or fragments but no surface rock and seldom more than 25% litter cover. Annual rainfall 400–800 mm (average 565 mm). The high restioid cover may account for the frequent presence of rodents and termites, both of which apparently clip the restioid stems into neat short pieces. Other fauna include dassie, small antelope, donkey, leopard, baboon, porcupine, aardwolf, small black ants and puffadders!

Special features: structurally this community is more uniform than the foregoing and is the most frequently encountered restioid of the well-drained habitats. The rare crucifer *Cycloptychis virgata* occurs sparingly in the drier, low-altitude sandflats (800m) along Pakhuis Pass. Community 1 of Mustart *et al.* (1993) is synonymous with my sandflats community.

Relationship of the sandflats Community 18 to Campbell's (1985) scheme: Community 18 comfortably fits the key characters and description of Fonteintjiesberg Azonal Restioid Fynbos, except that the conditions are generally less mesic and rocky than described and illustrated by Campbell. In the synonymy for Fonteintjiesberg Campbell cites 'much of Taylor's (1978) plateau communities,' with the qualification that 'the drier facies would be placed in Wolfberg'. Figure 8 in Taylor (1978) illustrates precisely the appearance and habitat of the northern Cederberg sandflats where greater aridity is to be expected. Hence, much of Community 18 would be Wolfberg Azonal Restioid Fynbos. Campbell's fig. 38, illustrating Wolfberg, depicts only one rather rare variation of my sandflats community. Figure 19 (this paper) with *Thamnochortus platypteris* dominant, shows its more usual appearance.

Community 19 *Hypodiscus neesii*–*Elytropappus scaber* Community on rocky slopes and gravelly flats (Figure 20)

Structural category: low mid-dense restioid shrubland with sparse emergent shrubs.

Relevés: (4) 7, 8, 64 & 65
Species richness: 30 (24–37)
Species group (Appendix 2): AN

Vegetation: mature; cover 70–90% (average 82%); one stratum to 1 m in height with sparse emergent shrubs to 2.5 m. The main stratum has a rich assortment of species, the restioids providing the highest cover (see Dominants) followed by two sedges, *Tetraria ustulata* and *T. cuspidata*. The shrubs, of the same height or lower than the hemicytrophites, are mainly leptosclerophyllous, e.g. *Elytropappus scaber*, *Stoebe plumosa*, *Agathosma pubigera*, *Selago lamprocarpa* and *Struthiola ciliata*. The emergents are also sclerophyllous shrubs, either with prickly leaves (*Metasia densa*, *Cliffortia ruscifolia*), soft leaves (*Anthospermum aethiopicum*), or the almost leafless semi-parasite *Thesium strictum*.

Dominants: three restioids, *Ischyrolepis sieberi*, *Hypodiscus neesii* and *Cannomois parviflora* form a highly constant mixture but they only become weakly dominant (cover 3) in one relevé each. None of the shrubs show clear dominance.

Locality and environment: this community has been recorded only from a small area on the eastern slopes of the Groenberg plateau around Fortyn-se-Kloof on the jeep track from Pakhuis to Heuningvlei. The relevés are on the lower or concave pediment slope (6), one on a nearly flat

plain (2.1), at altitudes of 870–980 m, the slope 2°–17°, N to NE (Figure 25); on sandstone of the Peninsula Formation; substrate of shallow yellowish brown sand or gravel 5–15 cm deep; rock and litter cover both variable (2–70% and 8–40% respectively), lowest on the plain. Annual rainfall 500–600 mm (average 550 mm).

Special features: the high species richness of this community is accounted for not by the diagnostics (there is only one, *Elytropappus scaber*) but by the high number of species it shares with other communities. This suggests a transitional status, and is reinforced by the fact that in environmental characteristics it fits but poorly into the sandy habitat group of communities (2.2). However, it cannot be placed elsewhere in Appendix 2 because it is connected by shared species both with the foregoing and the succeeding communities. It is nevertheless clearly distinguished from Community 18 by the absence of the large group of differentials for that community (species group AI) and from the succeeding communities by the absence of *Elegia filacea*. Relevé 64 on the flat plain (Figure 20) is atypical both in habitat and in structure: by the prominence of restioids and the lack of emergents it is structurally a true restioidland.

Relationship of Community 19 to Campbell's (1985) scheme: lacking the differentials of Community 18, Community 19 seems to be merely a variant of the Wolfberg–Fonteinjtjesberg Azonal Restioid group, occurring on slopes rather than flats, with a rocky, gravelly substrate rather than sand. Some relevés with non-ericaceous shrub cover almost equivalent to restioid cover may border on Asteraceous Fynbos, thus reinforcing the transitional status of this community.

C. FYNBOS OF POORLY DRAINED HABITATS (Communities 20–26)

The remaining seven communities in this classification (Communities 20–26, see Figure 6) are arranged along a gradient of increasing altitude and rainfall. They occur from 950–1 700 m above sea level on predominantly level

sites where the poorly drained soil is moist, wet or waterlogged for at least part of the year. They lack the species in group AP that characterize communities of well-drained sites but comprise no species group that unites all seven communities. The first four communities, 20–23, are distinguished by the full presence and strong dominance of *Elegia filacea* which is differential but not exclusive to them. In the same way the last two communities, 25 and 26, are distinguished by the differential species *Ischyrolepis curviramis*. In Community 24, *Tetraria* sp. nov. (T 11230) is differential and the other two are absent. These three differentials occur with less strength in the well-drained communities (section B) but are better adapted to the periodic inundation of section C. The probable ecological relationships within and between these community groups will be discussed in the sections that follow.

A major structural feature distinguishing the well-drained from the poorly-drained communities is that the latter are all restioidlands whereas the former, with the exception of Communities 16 and 18, are shrublands. I have standardized this distinction by defining shrubland as vegetation with a shrub cover exceeding 25% (B-B value 3 and over). Where the shrub cover is 5–25% (value 2) I have called it a restioidland with shrubs; where shrubs are less than 5% (value 1) I consider it a pure restioidland or, where appropriate, a sedge-land.

1. Mid-altitude plateaux and terraces (Communities 20–24)

1.1 Winter-wet habitats (Communities 20–23)

Elegia filacea restioidlands occur on winter-wet sites between 950 and 1 350 m in altitude. Communities 20 and 21, on shallow sand over bedrock below 1 000 m, are rich in species (average 29–35 taxa for 100 m²). The greater proportion of species are shrubs (\pm 60%) but the cover is predominantly restioid. Community 21 is the only community with a high rock cover and consequently a more open vegetation. Communities 22 and 23, on deeper sand at higher altitudes (1 100–1 320 m) are poorer in species (average 12–14 taxa per 100 m²) the greater pro-



FIGURE 20.—*Hypodiscus neesii*–*Elytropappus scaber* Community (No. 19) on a local gravelly flat adjoining Fortyn-se-Kloof at 870 m, relevé 64. *Hypodiscus neesii* is dominant but four other restioids and four sedges are present in this relevé with 32 spp.



FIGURE 21.—*Elegia filacea*–*Centella* cf. *recticarpa* Community (No. 21) on a rocky ridge, the only *Elegia* restioid with a high rock cover, relevé 127.

portion of which (60–70%) are hemicytrophites, the cover predominantly restioid. The strongest dominance of *Elegia filacea* is in Community 23 which has the lowest species richness and highest altitude of all four communities in this category.

Community 20 *Elegia filacea*–*Tetraria* sp. nov. (T 11230) Community on shallow sand over bedrock

Structural category: closed restioid with low sparse shrubs.

Relevés: (3) 72, 74 & 153

Species richness: 29 (26–30)

Species group (Appendix 2): nil

Vegetation: young-mature (± 7 –10 years post-burn); cover 80–95% (average 89%); one stratum up to 0.7 m tall. Hemicytrophites predominate in cover and comprise an average of 44% of the species in the relevés. Restionaceae as a family are strongly dominant, the sedges sometimes co-dominant. The shrubs are lower in stature and relatively inconspicuous but quite rich in taxa, mainly leptosclerophyllous, some spiny-leaved, e.g. *Metalasia densa*. There are no diagnostic species for this community.

Dominants: species are individually not stronger than cover 3, usually only one species per relevé: *Elegia filacea*, *Tetraria* sp. nov. (T 11230), *Cannomois parviflora*, *Willdenowia arescens* and *Ischyrolepis curviramis*.

Locality and environment: near Amon-se-Poort and north of Ribboksberg, on level or slightly sloping (0° – 5°) local flats (2.1) with N aspect, average altitude 950 m; on Peninsula (C1Q1) or Nardouw (C1Q2) Formation; substrate yellowish, shallow (10–15 cm) silty sand with pebbles over bedrock, poorly drained, with free surface water standing after rain; no rock cover, litter negligible except in relevé 153 (20%). Annual rainfall 500–800 mm (average 666 mm).

Special features: sparse seedlings of *Protea laurifolia* on or near all three relevés suggest that in its mature condition this community has a tall proteoid overstorey or emergents.

Community 21 *Elegia filacea*–*Centella* cf. *recticarpa* Community on rocky terraces over bedrock (Figure 21)

Structural category: mid-dense restioid with low sparse shrubs

Relevés: (2) 127 & 128

Species richness: 35 (32–37)

Species group (Appendix 2): AU

Vegetation: young-mature (± 7 years post-burn); cover 78–80%; one stratum up to 0.6 m tall. Hemicytrophites, especially restioids, predominate in cover and comprise 38% of the species. Shrubs are about the same height as the hemicytrophites, numerous in species but never dominant, mainly leptosclerophyllous in form except the diagnostic *Centella* cf. *recticarpa* which has tufted fili-form leaves up to 90 mm long.

Dominants: only *Elegia filacea* with a cover of 3 or 4.

Locality and environment: on the rocky ridge running transversely between Kliphuis Peak and Ribboksberg in the Pakhuis range, on small local terraces on the plane slope (5.1) with a gentle (4°) south slope at 950 m altitude; Nardouw Formation (C1Q2). The coarse stony sandstone soil, less than 10 cm deep over bedrock, is better drained than the other *Elegia filacea* communities, with surface flow and subsurface percolation occurring after rain. Rock cover, including exposed bedrock, is very high (98%); litter cover 6–10%. Annual rainfall 500 mm.

Special features: this is the only one of the four *Elegia filacea* communities that has a high cover of exposed rock

and reasonably good drainage. As a consequence it has a more open canopy and a higher number of species, especially differential shrubs, than other communities in this group. Its relatively young post-burn age, low stature and richness in species suggest that it may be a fire sere of a taller restioid shrubland as yet unsampled.

Community 22 *Elegia filacea*–*Staberoha aemula*

Community on deep sand on the Groothoek plateau

Structural category: closed restioidland

Relevés: (3) 97, 98 & 105

Species richness: 14 (12–17)

Species group (Appendix 2): AX

Vegetation: mature; cover 90–95%; one stratum up to 0.8 m tall. Restioids provide the greatest cover and hemicyptophytes comprise, on average, 70% of the species. The restioids are nearly all tufted, some stiffly erect (e.g. *Hypodiscus laevigatus*), others more compact and cushion-shaped (*Ischyrolepis curviramis*) with shorter sedges like *Ficinia petitiana* beneath the main canopy. The few shrubs are mostly leptosclerophyllous and inconspicuous.

Dominants: *Elegia filacea* and *Staberoha aemula*; *Tetarraria* sp. nov. (*T* 11230) subdominant in relevé 97.

Locality and environment: on the plateau (1.2) between Groothoek and Moedersielshoek above Heuningvlei, on the lower eastern slopes of the Krakadou range, on level sites at 1 100 m altitude; on Peninsula Formation (C1Q1). The substrate is a white sand 25 cm to over 1 m deep, occurring in situations that could become wet or even waterlogged in the rainy season; no surface rock; litter cover 10–15%. Annual rainfall 800 mm.

Special features: the whole of the Groothoek Plateau consists of deep sand, the better drained parts having been largely planted with cedars. The remaining open areas are

either moister depressions and flats bearing the present community, or small mounds with the sandflats community 18; there are few transitional situations.

Community 23 *Elegia filacea*–*Ischyrolepis virgea*

Community on sand on the Groenberg plateau (Figures 22 & 23)

Structural category: closed restioidland with low sparse shrubs with or without emergent mid-high proteoid shrubs

Relevés: (3) 51, 59 & 60

Species richness: 12 (9–16)

Species group (Appendix 2): nil

Vegetation: mature; cover 95–100%; one stratum up to 0.85 m in height. Hemicyptophytes predominate in cover and comprise an average of 61% of the species. Restionaceae are frequent and strongly dominant, sedges sparse, grasses negligible. The few shrubs in the main stratum are mainly leptosclerophyllous, the emergents proteoid: *Leucadendron concavum*, endemic to sandy plateaux in the northern Cederberg, and *Protea repens* uncommon in the northwestern mountain complex (Figure 23).

Dominants: *Elegia filacea* strongly dominant in all relevés, *Cannomois parviflora* less strongly dominant in relevé 60 only.

Locality and environment: on the high-altitude Groenberg plateau (1.2) north of Krakadou, on level sites at altitude 1 240–1 320 m (average 1 273 m) on Peninsula Formation (C1Q1). Substrate is a pinkish white or yellowish sand less than 50 cm deep. There is no surface rock but quartz pebbles often cover as much as 90% of the surface. The impervious level bedrock at 15–50 cm below the surface may impede drainage to the extent that local sites could become temporarily waterlogged after heavy rain. Litter cover 8–10%. Annual rainfall 800 mm.



FIGURE 22.—*Elegia filacea*–*Ischyrolepis virgea* Community (No. 23) on a sandy platform at 1 260 m on Groenberg plateau, relevé 59. *Elegia filacea* strongly dominant. Quartz pebbles cover 90% of surface.



FIGURE 23.—*Elegia filacea*–*Ischyrolepis virgea* Community (No. 23) on Groenberg plateau, with emergent *Protea repens* to 1.5 m tall, 1 320 m, relevé 60. *Leucadendron concavum* is present but inconspicuous.

Special features: this community is distinguished from the three foregoing restiolands by the absence of the diagnostic species for Communities 21 and 22 and the presence in some instances of proteoid emergents. Because *E. filacea* is so strongly dominant and other species relatively inconspicuous, this community looks more like a single-species 'meadow', especially when the emergents are lacking, than any of the preceding *E. filacea* restiolands (Figure 22).

The local endemic *Leucadendron concavum* is listed in the Red Data Book (Hall & Veldhuis 1985) as 'vulnerable' and 'known from two populations a few kilometres apart'. These remarks refer to the accessible populations on the Pakhuis Plateau at about 900 m in altitude but I have found several smaller populations on isolated flatlands of the Groenberg plateau at altitudes above 1 200 m.

1.2 Permanently moist habitats (Community 24)

Community 24 *Tetraria* sp. nov. (T 11230)–*Elegia asperiflora* Community on seepages

Structural category: closed sedge-restioid

Relevés: (3) 73, 165 & 179

Species richness: 14 (10–19)

Species group (Appendix 2): BB

Vegetation: young-mature to mature; cover 94–100% (average 97%); one stratum up to 1 m tall. Hemicryptophytes provide by far the greater cover and comprise an average of 67% of the total number of taxa. Cyperoid (sedge) and restioid species are co-dominant. As may be expected in such a specialized habitat some species are narrowly confined to seepages, e.g. the herb *Utricularia capensis*, the sedges *Fuirena hirsuta*, *Chrysithrix junciformis*, *Epischoenus gracilis*, the juncoid *Juncus capensis*, the grass *Andropogon appendiculatus* and the dominants. Shrubs

are few in number, low in stature and cover, usually leptophyllous but a few are sclerophyllous.

Dominants: *Tetraria* sp. nov. (T 11230), *Elegia asperiflora*, *Restio occultus* and *Macrochaetium ecklonii*, each tending to dominate singly and strongly on a particular site.

Locality and environment: this azonal community is thinly scattered throughout the Cederberg wherever there is seepage or at least perennially moist soil. This specialized edaphic condition is found either in high-altitude shallow stream valleys or where there is an abrupt break in a gentle slope, forming a terrace 'step' \pm 1–3 m high, usually underlain by an impervious rock band which may protrude at the bottom of the step. Altitudes for the relevés vary from 930–1 570 m, aspects N or S 5°–14°, on sandstones of C1Q1 and C1Q2 Formations. Substrates are fine sand or clayey silt with a high organic content yielding a black or dark chocolate-brown deep soil with no rock cover and low litter (5%). Annual rainfall 800–1 200 mm (average 1 040 mm).

Special features: seepage communities are rare and of limited extent but of distinct appearance. They may be from 100 m² to a few hectares in area. The high cover and diversity of sedges is characteristic of the sedge-restioid community described here. There are, however, other seepage communities that, because of their rarity, have not been sampled in this survey. One is the *Epischoenus gracilis*–*Restio perplexus* sedge–restioid tussock at about 1 330 m on the Sneeuberg Hut plateau from which palynologists have described nearly 10 000 years of vegetation change (Meadows & Sugden 1990). There is the dense grassy tussock at Slangvlei, and a mixed seepage community near Moedersielshoek at the southern end of the Groothoek plateau where *Watsonia stokoei*, limited to the Cold Bokkeveld, Piketberg and Cederberg ranges, grows in profusion. Seepages, despite their small extent, are of greatest importance as 'sponges' for the controlled release of water to the streams and settlements below. Like estu-

aries they harbour a wealth of specialized organisms whose complex interactions need further careful study to ensure correct management of these valuable but vulnerable ecosystems.

2. Summit platforms (Communities 25 & 26)

These two communities are distinguished by the full presence and strong dominance of the taxon called *Ischyrolepis curviramis* in Appendix 2. A separate species, *I. nana*, has now been described for a high-altitude taxon that had generally been assumed to be conspecific with *I. curviramis* (Linder 1985). Both these closely related species occur in the Cederberg, *I. curviramis* at altitudes 'generally below 1 200 m', *I. nana* at high altitudes, 'rarely below 1000 m' (Linder 1985). Since most of my Cederberg field work was done before I was aware of the new species, I used the name *I. curviramis* for both concepts. Because it is virtually impossible to distinguish between the two species in retrospect from the key characters given by Linder (1985), I have retained the name *I. curviramis* for both species in Appendix 2. Whereas it can be safely assumed that the species occurring in Communities 25 and 26, at the highest altitudes in the northern Cederberg, is *I. nana*, the concept for the other occurrences of '*I. curviramis*' in Appendix 2 must remain mixed.

Community 25 *Ischyrolepis nana*–*Restio strobilifer* Community on high sandy platforms

Structural category: closed restioid

Relevés: (2) 167 & 170

Species richness: 5 (5–5)

Species group (Appendix 2): BF

Vegetation: mature; cover 90–98% (average 94%); one stratum scarcely 0.5 m tall, consisting solely of restioids and an occasional high-altitude sedge, e.g. *Epischoenus dregeanus* in relevé 170.

Dominants: *Ischyrolepis nana* with *Restio strobilifer* sub-dominant.

Locality and environment: upper levels of the Krakadou range below the final summit plateaux at altitude 1 550–1 600 m on almost level platforms (1.2); on Peninsula sandstone (C1Q1) with a substrate of fine grey (rather humic) or white sand up to 50 cm deep, with white quartz pebbles or fragments 1 or 2 cm in diameter scattered on the surface, moist during winter but becoming very dry in summer; no surface rock or litter but rocky beneath. Annual rainfall 1 200 mm.

Special features: this rare and local community needs further sampling to establish its status. It appears to be a variation of the summit tussock community (26) with slight amelioration of the harsh conditions prevailing there. The almost imperceptible slope of 1° or 2° would allow slow percolation of the surface water, thus effecting a less abrupt change in soil moisture status from winter-wet to summer-dry conditions. This is the most species-poor community sampled in the northern Cederberg.

Community 26 *Ischyrolepis nana*–*Pentaschistis densifolia* Community on flat summits ('summit tussock'; Figure 24)

Structural category: closed Restioid

Relevés: (3) 150, 158 & 163

Species richness: 7 (3–12)

Species group (Appendix 2): BG

Vegetation: mature cover 70–95% (average 82%); one stratum not taller than 0.35 m. The only important perennial is the cushion-like *Ischyrolepis nana* which gives this community its distinctive appearance. The only other constant perennial is the infrequent grass *Pentaschistis densifolia*. Succulents like *Senecio crassulifolius* and the mesem *Lampranthus scaber* are sometimes present with low frequency and cover. In the vernal aspect recorded in relevé 150 in November (still the spring season on high summits) nine other therophytes, chamaephytes and geophytes were listed, including *Laurentia arabidea*, *Hypo-*



FIGURE 24.—*Ischyrolepis nana*–*Pentaschistis densifolia* Community (No. 26) on a high platform on Groot Krakadou at 1 700 m. Rounded tussocks of *I. nana* are distinctive.

choeris glabra (an alien), *Hesperantha radiata*, *Spiloxene capensis*, *Drosera* sp. and *Heliclyrusum* sp.; *Pelargonium triphyllum* was added in January.

Dominants: only *Ischyrolepis nana*, strongly dominant.

Locality and environment: all three relevés were done at different seasons on different sites on the large flat summit (1.1) of Groot Krakadou but the community is to be found on other tabletops from Pilaarsberg at 1 000 m in the north to Tafelberg at nearly 2 000 m and probably further south. It occurs on Peninsula (C1Q1) and Nardouw (C1Q2) sandstones where the substrate is a coarse sand, on the surface white or grey and darker beneath, 5–40 cm deep with about 10% litter cover, confined to isolated rock-free corridors between protruding 'whalebacks' of the bedrock that underlies the sites. Annual rainfall on Krakadou is 1 400 mm.

Special features: the rigour of the environment on these tabletop summits is perhaps unequalled anywhere on Cape mountains. The microclimate at soil level ranges from extreme heat and drought in summer to freezing conditions with snow and ice in winter. After rain, the undrained soil rapidly becomes inundated and may either remain saturated for weeks in winter or dry out rapidly and completely after a summer thunderstorm. Southeast winds may ameliorate the summer air temperatures but can excessively desiccate the vegetation since they are seldom accompanied by the moist 'tablecloth' cloud in the northern Cederberg. The effect of these conditions on the vegetation has been to eliminate all but the hardiest plants. Were it not for the ephemerals that appear in the comparatively benign spring and early summer, this community would have the lowest species richness of any in the Cederberg. Because the corridors of summit tussock are isolated from one another by huge slabs and grotesque piles of bare rock, wildfires seldom penetrate; the vegetation is usually long unburnt but does not appear to be senescent.

Relationship of the level restioids Communities 22–26 to Campbell's (1985) scheme: the 'extremely high graminoid cover relative to shrubs' and the localized habitats, puts these five communities clearly into Campbell's Azonal Restioid Fynbos. 'Graminoid' here refers only to restioids (over 80%) and sedges (up to 20%), as the cover of true grasses is insignificant.

Communities 22 and 23 fall into the Wolfberg–Fonteinjiesberg group. Community 22 on lower drier sandy plateaux is probably 'Wolfberg'; Community 23 at higher altitude is more like 'Fonteinjiesberg' but the characteristic *Elegia filacea* 'meadowland' is not mentioned by Campbell.

Mature stands of Community 24, with the tall *Restio occultus*, have the structure described for Crystal except for the high cover of the sedge *Tetraria pleiostachys*. Communities 25 and 26 seem closest to Campbell's description of Snecukop which, however, is not recorded in the northwest. This very distinctive 'summit tussock' vegetation, though not confined to the Cederberg, is most

often found there and may well be an undescribed structural type. Although none of these local restioids can be readily identified to Campbell's type level, they all clearly fit his Azonal Restioid subseries which, as he states, 'always occupies localized sites.'

Discussion and conclusions

Method

The 26 communities revealed by the Braun-Blanquet phytosociological analysis are arranged in a natural hierarchy of units, defined by diagnostic species combinations, that correlate well with environmental factors of the region. Thus, the planner and manager with a field knowledge of some three dozen diagnostic species could use the classification to identify the main communities and hence the habitats. Because the classification reflects the environment it must have value as a management tool. This does not imply that each community is necessarily a separate ecological management unit. It is precisely the natural hierarchy inherent in a Braun-Blanquet classification that enables the ecologically and floristically related communities to be grouped together into fewer practical management units (Van Wyk & Bredenkamp 1986). In the Cederberg, for instance, further investigation might show the following groups of communities to be suitable for amalgamation into single management units: Thicket communities 1–4; Bedrock communities 5–7; the cedar community 11 with its putative variant (12); the waboom communities 13 and 14 possibly with the upper-altitude variant (15); some of the *Elegia filacea* restioids (20–23); and the summit tussocks (25–26).

The applicability of the Braun-Blanquet phytosociological methods to studies in southern African vegetation has been summarized *inter alia* by Werger (1977) and its practical application in conservation planning by Bredenkamp & Theron (1976). The opinion that this tabular synthesis of floristic data is useful in interpreting ecological factors is shared by earlier workers in mountain fynbos such as Werger *et al.* (1972), Boucher (1978), Taylor (1984a) and McDonald (1988, 1993a, b & c). A phytosociological classification may take more time than a structural classification but is more stable, precise and detailed. Fire, for instance, has a drastic effect on structure whereas floristic composition is more stable.

The floristic detail of a phytosociological table gives finer insights into the distribution and ecological requirements of species that are rare or vulnerable to specific factors of the environment; it also identifies sensitive specialized habitats by means of narrowly restricted species.

The structural classification of Campbell (1985)

Compatibility of the two systems, floristic and structural, seems greatest at the highest hierarchical level. At the level of series, ten of the eighteen fynbos communities in my analysis of relationships were identified as Restioid, seven as Asteraceous and one as Proteoid Fynbos. This is entirely consistent with Campbell's regional community complexes where he recognizes (p. 112) 'a Restioid-Asteraceous Fynbos Mountain Region (comprising the North-Western, Central and Southern Interior Mountain

Regions' which of course includes the Cederberg. At the subseries level, all the floristic communities occurring on localized, sandy, usually level sites, well drained or not, were identified as Azonal Restioid Fynbos. This is a good correlation of floristics and broad habitat features with structure. At the lowest level, the type, there is least congruence. The floristically well-defined Communities 8, 11 and 17 each contain three structural types, possibly more, yet each community occupies a physiographically homogeneous and distinct habitat which would be considered a single unit for management.

'Economy of time and effort' is said to be a major advantage of structural surveys. Yet it is doubtful whether the mass of complex structural data to be gathered and analysed in order to determine a vegetation unit at type level, would be easier or quicker than a floristic survey at community level. However, a simplified system, at the level of subseries or series, could well be quicker, easier to interpret and more effectively comparable to a floristic system.

Few of the attributes of a floristic classification are shared by a structural system. Nevertheless, the two systems can be seen as complementary. The floristic survey, which places more emphasis on presence or absence of a species (and, on that account, can encompass young vegetation as soon as post-burn seedlings or new shoots are identifiable) is most appropriate for long-term management, including the conservation of rare and endemic species.

The structural survey records mainly the amount of actual and relative cover of structural-functional forms and can be done without extensive *a priori* experience in field taxonomy. This will be more useful for monitoring in experimental and autecological studies which require a detailed record of short-term changes.

Habitat-floristic relationships within the study area

The species groups with broad amplitude reveal three major units, the first, Thicket (a variation of Acocks's Veld Type 4), the other two, Fynbos. Thicket, in terms of its floristics, structure and habitat, is clearly distinct from Fynbos, and the four thicket communities, occupying a small area of the Cederberg, are confined to riparian and mesic, fire-protected habitats. The thicket group as a whole is characterized by species group G (Appendix 2), comprising the tree *Podocarpus elongatus*, and the forest undershrub *Clutia pulchella*, both exclusive to this group but not frequent. The individual thicket communities are best recognized by their chief diagnostic species which are exclusive, fully present and often dominant, viz. *Olea europaea* subsp. *africana* in Communities 3 and 4, *Metrosideros angustifolia* in Communities 1–3, and *Brabejum stellatifolium* in Community 1. All thickets occur on sandstone of the TMS. Species richness in thickets, rather low relative to most fynbos communities in the Cederberg, is highest in Communities 3 and 4 where the substrate is moist but well drained, not phreatic.

Floristic connections of thicket with fynbos are few. Species group K (Appendix 2) comprising a tree, two shrubs and a woody climber, is shared by the Rocky streambank and Scree thicket Communities 3 and 4 and

the fynbos Bedrock Communities 5 and 6; the latter, like the former, are protected from fire by areas of bare rock. A broader connection is seen in species group AC (Appendix 2) comprising forest or forest precursor species that regenerate from base or stem coppice and thus can occur, but sparingly, in certain fynbos situations, notably on colluvial slopes (Communities 13 to 15) where boulders and rocks provide added shade, moisture and protection from less severe fires.

The first subdivision of fynbos into two groups on the basis of soil drainage has already been mentioned. The larger group—Communities 5–19 on well-drained soils—is defined by the presence of species group AP (Appendix 2) which is absent in the smaller group (Communities 20–26) on poorly drained soils. In the same way the first group on well-drained soils (Community 5–19) is subdivided by presence of species group AA in Communities 5–15 on rocky slopes, and its absence in Communities 17–19 on silty, sandy and gravelly flats. In both cases the smaller group has no shared defining species, implying that these smaller groups are ecologically as well as floristically more heterogeneous than the larger groups. In Appendix 2 these groups are further subdivided by progressively more restricted floristic parameters so that the extent of relationships can be seen at a glance. In interpreting Appendix 2 it must be noted that the defining group is considered to be present if only one of the species in the group, not necessarily the 'leading' or most frequent species, is present. For example, Communities 10 and 16 are placed in the well-drained section of Appendix 2 on the presence of *Ischyrolepis sieberi* despite the absence of *Ehrharta calycina* villosa.

Species richness in Cederberg fynbos communities, as in the thickets, is highest in the more favourable, less extreme habitats, the mid-slope Waboomveld Communities 13 and 14 with well-drained deepish colluvial soil and sufficient rainfall.

All the fynbos communities except two are on soils derived from the Table Mountain sandstones. The exceptions are the Pakhuis and Welbedacht shaleband Communities 8 and 17 on the Cederberg Formation. These are floristically distinguished from the rest, and, surprisingly, from each other, by quite a large number of diagnostic species that are exclusive to each of them. Despite this, their species richness is hardly higher than average, and they both show quite numerous higher-level floristic relationships with sandstone communities because the surface shale in both communities is admixed to some extent with sand and debris from the slopes above.

Comparison with other regions

The broad environmental groupings based primarily on soil moisture—thicket in stream Kloofs and screes, fynbos shrublands on well-drained slopes, restioids on flats with good or impeded drainage—are found in other mountain fynbos areas such as the Kogelberg (Boucher 1978), Cape Point (Taylor 1984b), parts of Table Mountain (Glyphis *et al.* 1978; Jeffery & Wilson 1987) and Zacharias-hoek (Van Wilgen & Kruger 1985). They also correspond roughly to the major habitat-vegetation complexes of the Upper Orange River Valley which Werger (1980) summa-

rizas as 'riverine forest and woodland vegetation, the shrubby vegetation of the slopes and the non-shrubby vegetation of the flats.' In Cape mountains, non-shrubby restioids are most extensive where the Table Mountain Formations are level or slightly tilted, as in the Cederberg and at Cape Point (Taylor 1984b), but are rare where flat topography is lacking as at Swartboskloof (McDonald 1988) and Orange Kloof (McKenzie *et al.* 1977). Even shrublands on slopes in the Cederberg have a strong restioid component, the shrubs, including the proteoids, being mainly leptophyllous (e.g. *Serruria*) and less conspicuous. In other mountain regions of the Cape System, shrublands dominated by tall proteoids with broad mesophyll leaves are common on the moister slopes. That such proteoid shrublands are nowhere as common in the Cederberg may be partly due to the generally more xeric conditions and partly to the biotic influences mentioned below.

Of particular interest is the high-level floristic similarity between some Cederberg communities and those of western Cape foreland vegetation. The leading species of Group AP that defines well-drained fynbos in the Cederberg (*Ehrharta calycina*) has been shown by Boucher (1987) to define the most widespread formal class of Cape foreland vegetation comprising five orders, many alliances and a host of associations in strandveld, lowland fynbos and renosterveld. Also, a smaller class of Boucher's (1987) thickets is defined by *Olea europaea* subsp. *africana* which is the leading species in group F that defines thickets of scree and sand in the Cederberg.

Biotic influences

Fortunately, the Cederberg is free of serious problems with invasive alien plants. For well over a century, however, the natural vegetation has been heavily exploited for grazing, for cedar timber and for medicinal shrubs such as buchu (*Agathosma betulina*) and bush tea (*Aspalathus*

linearis). These operations have largely involved the repeated and excessive use of fire which, enhanced by the comparatively dry conditions in the northern mountains, has resulted in severe degradation of the vegetation. These practices may partly explain two features of present day Cederberg vegetation. One is the large proportion and apparent permanence of highly inflammable shrubs in genera such as *Stoebe* and *Elytropappus* which in less degraded habitats are generally regarded as post-burn pioneers. The high biomass of these shrubs in a naturally xeric type of vegetation appears to have increased the fire danger and intensity to a level where frequent wildfires of 20 000 ha in area are not uncommon. The second feature is the scarcity of tall obligate seed regenerating shrubs (Van Wilgen & Kruger 1985). *Protea repens*, *P. punctata*, *P. magnifica* and even *P. laurifolia* are not common in the Cederberg today. The three first mentioned may be naturally infrequent because they are close to their northern limit of distribution, but *P. laurifolia* extends as far as the northern extremity of the fynbos escarpment near Nieuwoudtville. In the Cederberg it is much more common outside the State Forest than in comparable habitats within it. The increased size, frequency and intensity of wildfires at present, and the deleterious winter/spring management burns in the past, may partially explain this. Present policy stipulates that management burns should be carried out during late summer when best regeneration of obligate reseeders is obtained, and that the interval between burns should exceed the youth period for these species.

In general, restioids like the Sandflats (Community 18), where many of the subordinate plants are chamaephytes or short-lived reseeders, can and should be burnt at shorter intervals. This does not, however, apply to the high altitude Summit Tussock (Communities 25 and 26) where regeneration is slow and areas of bare rock limit natural fires.

4. Floristic analysis

Introduction

Since the preservation of species is a primary objective in the management of nature reserves, there is a need for complete inventories, especially of plants, in protected areas (Siegfried 1989). Moreover, inventories provide basic information for more detailed work on the preservation of biodiversity, the attributes of plants such as endemism, and an understanding of the dynamics of plant communities, aimed particularly at the prioritization of reserved areas and at applying appropriate management principles to them. With this in mind, and considering the phyto-geographic importance of the Cederberg situated near the northwestern extremity of the Cape Floristic Region, I decided to expand my preliminary short list, drawn up as an aid to field identification, to a full floristic inventory of the whole Cederberg Wilderness and Mountain Catchment Area. Its situation and extent, and its historical and environmental setting, are described in Chapter 2.

Checklists and floristic analyses had previously been published for local areas in the better known species-rich southwestern parts of the Cape Floristic Region (Boucher 1977; Olivier 1979; Taylor 1985; McDonald & Morley 1988; Buys *et al.* 1991), and in the south and east (Fourcade 1941; Olivier 1977, 1983; Van Wyk *et al.* 1988), but no similar data were available for the lesser known north-west of the Region.

Comparison of three local floras

A floristic analysis of the Cederberg (Table 1) is followed by tabulated data (Tables 2–4) that examine and attempt to explain the differences between mountain floras in the northwestern and southwestern parts of the Cape Floristic Region (CFR). For this purpose the flora of the Cederberg was compared with two similar-sized floras (1 100–1 800 species) in the southwest, namely the Cape Hangklip area (Boucher 1977), here referred to by the symbol CHA, and the Cape of Good Hope Nature Reserve (Taylor 1985), usually referred to as Cape Point (CPT). Both the latter areas are within the cooler and wetter part of the CFR where the highest concentration of many dis-

tinctive elements of the Cape flora occurs (Cowling & Holmes 1992).

Table 2 shows that the species density of 1.4 species per km² in the Cederberg is far lower than the densities in southwestern mountains: 5.9 for CHA, 14.0 for CPT. Whether or not this reflects a real low species *diversity* at the alpha, beta or gamma level—or at all three—remains to be investigated by more sophisticated techniques. The Cederberg, however, despite its much larger size, does have a smaller range of habitats than the southwestern areas. It has lower extremes of total rainfall but a higher proportion of winter rain and longer periods of summer drought. It has poorer and less diverse soils—no granite, smaller and less diversified areas of shale, no coastal sands—and a simpler geological structure. The near-horizontal strata with complete lack of folding (rare in Cape orogenesis) results in taller cliffs, fewer long gentle slopes, fewer moist habitat types but larger level plains and high plateaux of shallow sand over bedrock. In short, an impoverished environment is repeated within an area much larger than those of the southwestern landscapes discussed here.

Table 2 also shows that the species-to-genus ratio in the Cederberg (4.3 species per genus) is higher than that in the southwest (3.3 for CHA, 2.8 for CPT). This suggests that the Cederberg, with larger genera, may be an important centre of local species radiation (cf. Goldblatt 1978: 384). Alternatively, or in addition, the Cederberg represents a meeting place where elements from the driest floras of the winter rainfall region in Namaqualand and the western Karoo overlap the wetter floras of the south.

Table 3 shows the extent to which the total floras of the three areas are concentrated in their ten largest families and genera. Data summarized in Table 4 show that in all three floras, and in the CFR, the five largest genera comprise about 14% and the ten largest about 20%, of total species. The congruence of these figures is reassuring evidence for the close biological relationship, not only between the three local floras but also between them and the CFR as a whole.

TABLE 1.—Analysis of the flora showing the number of each taxon and the percentage that each contributes to the total flora

	Pteridophytes		Gymnosperms		Monocotyledons		Dicotyledons		Total
	No.	% of total	No.	% of total	No.	% of total	No.	% of total	
Families	12	12.4	2	2.1	18	18.5	65	67.0	97
Genera	16	3.9	2	0.5	123	30.1	268	65.5	409
Species	25	1.4	2	0.1	519	29.2	1232	69.3	1778

TABLE 2.—Comparison of floristic and areal data for three local floras

Local flora	Fam.	Gen.	Spp.	Spp. per genus	Area (km ²)	Spp. per km ²
Cederberg (CED)	97	409	1778	4.3	1260	1.4
Cape Hangklip (CHA)	110	430	1407	3.3	240	5.9
Cape Point (CPT)	87	395	1091	2.8	78	14.0

In a similar study Hilliard & Burt (1987) considered that the close similarity between the floras of the southern Drakensberg (23% in the ten largest genera) and the CFR (20%) ‘almost certainly stems from their representing biologically coherent areas.’ By contrast, statistics from very large areas with political, as opposed to biological or environmental boundaries show a different picture: in Natal Province as a whole the ten largest genera contribute only 12% to the total flora (Hilliard & Burt 1987) and in the Cape Province as a whole, 15% (Goldblatt 1978: table 7). In large regions with boundaries unrelated to natural units, there are many small and few large genera because the floras are more diverse, comprising a heterogeneous assemblage of taxa.

Whether the differences between individual local floras are significant or not, Table 4 shows that CHA has marginally the highest percentage of species in large genera at both the five and ten-genus level (15% and 21% respectively), Cederberg is slightly lower (14% and 21%) and CPT lowest (11% and 18%). For families the same pattern is more distinct. Hence, although all three mountain floras exhibit a similar pattern of composition, the

CHA flora consistently has the greatest concentration of species within a few large taxa. For an explanation of this regularly repeated sequence we look to the environment and vegetation of the three areas.

CHA has the highest precipitation and greatest extremes of relief: it consists almost entirely of strongly folded mountains of Table Mountain Group sandstones bearing the highly diverse assemblage of fynbos plants typical of the mountains of the southwestern Cape; there is minimal intrusion of coastal or other lowland vegetation such as renosterveld. The Cederberg, a drier landscape of lower rainfall, bears a modified fynbos penetrated on its eastern and western sides by tongues of Karoo-like shrubland and sandveld. At CPT the smaller proportion of mountains is clothed with typical fynbos but on the long shoreline there is a strong coastal component and on the extensive central plateau an abundance of marshy seeps and shallow-soiled flats. In short, the area with the largest proportion of mountain environment, CHA, bears the flora with the greatest concentration of species within a few large genera—a characteristic of typical fynbos of the CFR (Goldblatt 1978).

Family and genus sequences in the Cederberg

Although Asteraceae is the most species-rich family in all three floras in Table 3, in the Cederberg it contributes a considerably higher proportion to the total flora—13.4% compared with an average of 10.9% for the other two floras. Cederberg has remarkably few annual composites, even in genera such as *Felicia* and *Ursinia*, but the shrubby genera are well represented, especially in the drier habitats. Over 80% of Cederberg species of *Euryops*, *Relbunium*, *Oedera*, *Othonna* and *Pteronia*, for example, inhabit high-altitude, well-drained rocky outcrops or inland

TABLE 3.—Numbers and cumulative percentages of species in the 10 largest genera and 10 largest families of the three local floras within the Cape Floristic Region

Cederberg (CED)			Cape Hangklip (CHA)			Cape Point (CPT)		
Total no. of species 1778			Total no. of species 1407			Total no. of species 1091		
	No. of spp.	Cum. %		No. of spp.	Cum. %		No. of spp.	Cum. %
Genera								
<i>Erica</i>	83	4.7	<i>Erica</i>	98	7.0	<i>Erica</i>	38	3.5
<i>Aspalathus</i>	54	7.7	<i>Aspalathus</i>	35	9.5	<i>Ficinia</i>	26	5.9
<i>Agathosma</i>	41	10.0	<i>Ficinia</i>	27	11.4	<i>Aspalathus</i>	22	7.9
<i>Pelargonium</i>	34	11.9	<i>Restio</i>	22	13.0	<i>Senecio</i>	19	9.6
<i>Crassula</i>	30	13.5	<i>Senecio</i>	21	14.5	<i>Tetraria</i>	19	11.3
<i>Pentstemon</i>	28	15.2	<i>Cliffortia</i>	19	15.9	<i>Cliffortia</i>	17	12.9
<i>Phyllis</i>	27	16.7	<i>Elegia</i>	18	17.2	<i>Crassula</i>	17	14.5
<i>Oxalis</i>	26	18.2	<i>Pelargonium</i>	17	18.4	<i>Thesium</i>	16	16.0
<i>Senecio</i>	25	19.6	<i>Helichrysum</i>	16	19.5	<i>Restio</i>	12	17.1
<i>Ficinia</i>	24	20.9	<i>Lobelia</i>	16	20.6	<i>Pelargonium</i>	12	18.2
Families								
Asteraceae	238	13.4	Asteraceae	152	10.8	Asteraceae	120	11.0
Iridaceae	139	21.2	Ericaceae	119	19.3	Iridaceae	78	18.1
Fabaceae	126	28.3	Fabaceae	103	26.6	Cyperaceae	74	24.9
Ericaceae	100	33.9	Restionaceae	100	33.7	Fabaceae	70	31.3
Restionaceae	87	38.8	Iridaceae	98	40.7	Poaceae	64	37.2
Scrophulariaceae	83	43.5	Cyperaceae	71	45.7	Restionaceae	60	42.7
Rutaceae	70	47.4	Poaceae	64	50.2	Orchidaceae	59	48.1
Poaceae	69	51.2	Proteaceae	62	54.6	Ericaceae	48	52.5
Cyperaceae	67	54.9	Orchidaceae	55	58.5	Mesembryanthemaceae	28	55.1
Proteaceae	52	57.8	Campanulaceae	44	61.6	Proteaceae	24	57.3

TABLE 4.—The percentages of the total number of species within the three local floras and the CFR (Cape Floristic Region), that are contained within the first five and first ten families and genera of the floras

		CED	CHA	CPT	CFR
Families	First five	39	41	37	42
	First ten	58	62	57	57
Genera	First five	14	15	11	14
	First ten	21	21	18	20

foothills of Campbell's (1985) Dry Asteraceous Fynbos. Many species in these genera extend eastward into karroid shrubland or northward into the succulent Karoo of Namaqualand. *Euryops* has its highest concentration in the Karoo, and several Karoo species have their southernmost outposts in the dry interior valleys of the Cape including the Cederberg (Nordenstam 1969). Bremer (1976) points out that none of the species of *Relbunium* is typically representative of either the Cape or the Karoo floras: their distribution is determined mostly by soil type. It appears that the Cederberg is within an area of overlap between typical fynbos with a core of taxa in the southwestern Cape, and Namaqualand and western Karoo shrublands which comprise a subsidiary centre of speciation.

The family Iridaceae is highly ranked for the same reason: the Cederberg shares some species from the rich Namaqualand region with some from the fynbos region to the south. A few examples among the many species in the northern centre are *Babiana crispata*, *Ferraria ferrariola*, *Galaxia stagnalis*, *Gladiolus pritzelii*, *G. uysiae* and several species of *Moraea* and *Romulea*.

In the Fabaceae—third largest family in the Cederberg—the genus *Wiborgia* shows similar distribution traits. Species of that genus have deciduous leaves and are found in arid fynbos as well as in 'subdesert scrub' northward in Namaqualand (Dahlgren 1975).

Scrophulariaceae and Rutaceae rank sixth and seventh respectively in the Cederberg flora but are absent from the ten largest families at CPT and CHA. There is a very high component of annuals in Cederberg Scrophulariaceae, especially in genera such as *Diascia*, *Nemesia*, *Polycarena* and *Zaluzianskya*, and many new species are being described in current revisions. Dr O.M. Hilliard's new genus *Trieneena*, for example, has five new species that are endemic to the Cederberg, and seven out of a total of nine in the genus, occur there (Hilliard 1989).

The Rutaceae owes its prominence chiefly to the genus *Agathosma* which accounts for nearly 60% of rutaceous species in the Cederberg and is the third largest genus in that flora. *Agathosma* species seem to favour rugged rocky outcrops and well-drained sands (P.A. Bean pers. comm.), habitats common in the uniquely unfolded stratal configuration of the Cederberg Mountains referred to earlier. In his revisions of other genera in Diosmeae, Williams (1982) has reported concentrations of taxa inhabiting mainly rocky situations in the drier inland ranges of the Cape, including the Cederberg. *Diosma*, for instance, has a secondary concentration in the Clanwilliam District in

which the Cederberg is situated. Two of the species there, *D. acmaeophylla* and *D. ramosissima*, extend into Namaqualand as far north as Springbok. This is an almost unique range extension in Cape Diosmeae which are narrowly confined to the CFR (Williams 1982). *Macrostylis* occurs only west of the east-west fynbos divide at approximately 20° E longitude (Taylor 1979; Williams 1981) and extends northward via the Cederberg and Gifberg to the vicinity of Vanrhynsdorp. Nearly all species in both *Acamadenia* and *Euchaetis* in the Cederberg grow on rocky upper slopes and have their northern limit there (Bond & Goldblatt 1984).

In the rank sequences for genera (Table 3), *Erica* takes first place in all three floras but is most species-rich in CHA. This is consistent with Campbell's (1985) physiognomic category, Ericaceous Fynbos, which is best represented on the cool, moist slopes of high-altitude, high-rainfall mountains. Of the five types of Ericaceous Fynbos described by Campbell, four are recorded in CHA but only the fifth, the drier type, in the Cederberg.

Four genera ranking among the ten largest in the Cederberg are less well represented in the other two floras—*Agathosma*, *Pentastichis*, *Phyllica* and *Oxalis*—and *Agathosma* has already been discussed under Rutaceae.

It is unusual, especially in the western part of the CFR, to find a grass genus as high in the sequence as *Pentastichis* is in the Cederberg. However, after intensive collecting, the revision by Linder & Ellis (1990) brought to light at least eight new species and four revised names for the Cederberg, many of them confined to high mountains in the northwest of the Fynbos Biome. Recently described taxa of *Pentastichis*, recorded in the Cederberg checklist, were unknown when the lists for CPT and CHA were compiled. This unilaterally increases the tally for Cederberg, reducing the validity of the comparison with the other two floras.

Phyllica, a very large genus of 182 taxa, occurs almost exclusively within the CFR, mostly from an altitude of about 350 m to the tops of the highest peaks. Pillans' (1942) observation that 'the majority [of *Phyllica* species] show a preference for exposed and comparatively dry situations' is perfectly consistent with environments in the Cederberg.

Oxalis is a cosmopolitan genus with one concentration in South Africa where 'the great bulk of the species occur in the western coastal belt from Cape Town to Namaqualand, including the western parts of the Ceres and Calvinia Divisions' (Salter 1944). The Cederberg falls exactly within this range and, as already noted, includes habitats that would favour species from the drier northern and eastern regions as well as those from the moister regions further south. In addition, the rigorous climate of the Cederberg, with extreme summer drought and heat, and the generally open vegetation cover, would favour the survival of the geophytic life form. With 26 of the 208 species recognized by Salter fifty years ago, the Cederberg can boast one-eighth of the *Oxalis* flora of South Africa!

Two typical Cape genera, *Restio* and *Cliffortia*, are notably absent from the ten largest genera in the Cederberg.

The absence of *Restio* is due to an artefact of taxonomy similar to that mentioned for *Pentaschistis*. Linder's (1985) conspectus of Restionaceae, in which *Ischyrolepis* is split off from *Restio*, effected a drastic reduction in *Restio* species in the Cederberg which was not reflected in the two earlier checklists for CPT and CHA. The absence of *Cliffortia* from the ten largest genera in the Cederberg, indicates that this genus is more strongly concentrated in the southwest and south of the CFR than in the northwest. This is confirmed by the distribution-density maps I and II given by Weimarck (1934) for the genus.

Finally, less conspicuous families and genera excluded from Table 3 provide further evidence for viewing the Cederberg as a meeting place of two floras. For example, the woody shrubs *Diospyros ramulosa* and *Euclea lancea* (Ebenaceae) with distribution centres in Namaqualand, *E. linearis* from Transvaal and tropical Africa, and *Poleman-niopsis marlothii* (Apiaceae) from the western Karoo, all have their southernmost localities in the Cederberg. Similarly, eastern forest taxa such as *Cassine peragua*, *Hartogiella schinoides* (Celastraceae) and *Platylophus trifolius* (Cunoniaceae), and eastern shrubland species like

Euclea acutifolia and *E. natalensis* (Ebenaceae) extend as far as Cederberg or Gifberg in the extreme northwest.

Conclusions

For its large area the Cederberg is poorer in total species than two local mountain floras in the southwest of the CFR. This may be partly due to the relatively small range of habitats in the Cederberg compared to those in the southwestern mountains. Nevertheless, the fact that Cederberg genera, on average, contain more species than their southwestern counterparts suggests that the Cederberg may be an important local centre of radiation. The Cederberg is, moreover, a meeting place where the driest flora of the winter rainfall region in the north overlaps the wetter flora of the south, as is evident from the many examples of shared taxa given above.

This lack of distinction between floristic boundaries supports Bayer's (1984) case for a wider concept of the CFR which would embrace the northern part of the winter rainfall region, as well as the region of Cape fold mountains, thereby creating a greater awareness of the need for better conservation of the flora and vegetation of the northern part.

Acknowledgements

I am grateful to the many people who have helped me in various ways during the progress of this work. In particular, I would like to thank Dr J.C. Scheepers for wise and enthusiastic guidance throughout the project; Dr Charlie Boucher for invaluable discussions and assistance with the table shuffling; Mrs Jo Beyers for patient and painstaking help with the final preparation of the manuscript; Mrs Judith Leith for efficient typing of the entire text and checklist.

My thanks are due also to the following: many friends and forest rangers especially Mr Izak Koopman and Mr Saul Hendricks for assistance and companionship in the field; Ms W. Smith and Mr F. Ockhuis for typing and general assistance in Clanwilliam; the Director-General of the Cape Department of Nature Conservation and local conservation personnel for providing accommodation and permission to work in the Cederberg; Ms M. Morley and Messrs J. van Blerk, M. Panagos and D.J. McDonald for help with computer processing and Mrs J. Saunders for word processing.

Most of my specimens were identified by the research staff of the Botanical Research Unit at Stellenbosch (now the Stellenbosch Herbarium of the National Botanical Institute, soon to be incorporated into the Compton Herbar-

ium), but some groups were determined by specialists, notably the following: Mrs Anne Bean (Rutaceae), Mrs Jo Beyers (*Lachnaea*), Mr Bill Burt (Apiaceae), Dr Peter Goldblatt (Iridaceae), Dr Olive Hilliard (many Scrophulariaceae), Dr Peter Linder (Restionaceae and *Pentaschistis*), Mr Ted Oliver and Mrs Inge Oliver (Ericaceae), Dr Dee Paterson-Jones (Amaryllidaceae and other monocots), Ms Pauline Perry (*Bulbinella* and *Eriospermum*), Dr John Rourke (Proteaceae), Prof. Adri van der Walt and his team (*Pelargonium*), Prof. Ben-Erik van Wyk (*Lotononis*) and Mrs Loretta van Zyl (*Zygophyllum*). Many of these also provided lists of localities for taxa on which they are currently working and Mrs Carole de Wet of PRE provided specimen data from the Pretoria National Herbarium Computerized Information System (PRECIS). I thank them all most sincerely.

I am indebted to the Department of Agriculture and Water Supply for funding the project; to the Director of the National Botanical Institute for permission to publish the work; and to Dr O.A. Leistner and editorial staff of *Strelitzia* for the final tedium of editing.

Lastly I thank my wife. Without her quiet support and constant encouragement this work might never have been completed!

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Checklist

This checklist of vascular plants in the Cederberg was compiled from the following sources:

1, my own collections from the mid-1950's to 1994 (numbers prefixed by the letter 'T');

2, all species cited by Bond & Goldblatt (1984) as occurring within the Cederberg;

3, extensive searches in Cape herbaria (BOL, NBG, SAM and STE) for Cederberg records of species cited by Bond & Goldblatt (1984) as occurring in non-coastal habitats in the Clanwilliam District;

4, literature, especially taxonomic revisions published from 1983 onwards, where authors refer to, or cite specimens from localities within the Cederberg;

5, specimen or locality citations given to me by authors of current revisions;

6, a PRECIS printout, dated 28.3.1990, of the grid-square 3219 AC (90% of which falls within the study area) for collection records from Cederberg localities (cited as 'PRECIS 1990');

7, a manuscript list, dated 1984, of Cederberg collections held by the erstwhile Department of Forestry's herbarium at Jonkershoek (cited as 'Forestry 1984'). Many of these specimens are now housed at PRE;

8, a few voucher 'field-specimens' held in 1986 at the Algeria centre in the Cederberg (cited as 'Forestry 1986');

9, a few records of additional well-known plants that were observed during my survey but not recorded from other sources (cited as 'Taylor sight records').

In the list, voucher specimens are printed in italics. Literature references quoted in the list are cited in full in the References. Naturalized exotic species are marked with an asterisk (*). There are no longer any invading alien plants in the conservation area. Alien species in commercial plantations, and ornamentals planted in the administrative and residential complexes, are excluded from the list. The symbols X (extinct), E (endangered), V (vulnerable), R (critically rare), I (indeterminate) and U (uncertain) given for some taxa in the list indicate their threatened status category, according to Hall & Veldhuis (1985).

A card index that records locality details of my specimens and some others, is available for reference at my home address where I also keep a small collection of duplicate 'mini-specimens'. Most of my original specimens are housed at STE or PRE; some early numbers, and duplicates, may be in BOL, NBG or SAM. My specimens were identified by the research staff of these herbaria, especially STE, or by specialists working elsewhere.

Taxa are recorded to species level, subspecific ranks being excluded. Specimens that could be named only to genus level are recorded as 'sp.' for a single specimen or as 'spp.' where more than one taxonomic concept may be implied. The latter usually indicates that the taxon is currently being revised; such cases were often discussed with the taxonomists concerned.

Nomenclature follows Arnold & De Wet (1993) but author names are abbreviated in accordance with Brummitt & Powell (1992). The checklist was brought as up to date as possible on completion in April 1994.

PTERIDOPHYTA

ADIANTACEAE

Cheilanthes

- capensis* (Thunb.) Sw., Schelpe & Anthony 1986
- contracta* (Kunze) Mett. ex Kuhn, T 10573
- depauperata* Baker, Schelpe & Anthony 1986, U
- hastata* (L.f.) Kunze, Schelpe & Anthony 1986
- induta* Kunze, T 10595, 11496, 11841
- multifida* (Sw.) Sw., T 11318, 11907, 12228
- Pellaea pteroides* (L.) Prantl, T 11476, 11563, 11990

ASPIDACEAE

- Polystichum monticola* N.C. Anthony & Schelpe, Schelpe & Anthony 1986
- Dryopteris callolepis* C. Chr., Schelpe & Anthony 1986

ASPLENIACEAE

- Ceterach cordatum* (Thunb.) Desv., Schelpe & Anthony 1986

BLECHNACEAE

Blechnum

- australe* L., Schelpe & Anthony 1986
- inflexum* (Kunze) Kuhn, Schelpe & Anthony 1986
- punctulatum* Sw., Schelpe & Anthony 1986

DENNSTAEDTIACEAE

- Pteridium aquilinum* (L.) Kuhn, Schelpe & Anthony 1986

GLEICHENIACEAE

- Gleichenia polypodioides* (L.) J.E. Sm., T 7474

HYMENOPHYLLACEAE

- Hymenophyllum tunbridgense* (L.) J.E. Sm., Schelpe & Anthony 1986

LYCOPODIACEAE

Lycopodium

- carolinianum* L., Schelpe & Anthony 1986
- cernuum* L., T 12258

OPHIOGLOSSACEAE

- Ophioglossum bergianum* Schldtl., Schelpe & Anthony 1986

OSMUNDACEAE

- Osmunda regalis* L., T 12035
- Todea barbara* (L.) T. Moore, T 12036, 12063

SCHIZAEACEAE

- Mohria caffrorum* (L.) Desv., T 11833, 11934, 11989
- Schizaea*
- pectinata* (L.) Sw., T 11726
- tenella* Kaulf., Schelpe & Anthony 1986

SELAGINELLACEAE

Selaginella pygmaea (*Kaulf.*) *Alston*, Schelpe & Anthony 1986

GYMNOSPERMAE

CUPRESSACEAE

Widdringtonia cedarbergensis *Marsh*, Bond & Goldblatt 1984, V

PODOCARPACEAE

Podocarpus elongatus (*Aiton*) *L'Hér. ex Pers.*, T 7484

ANGIOSPERMAE-MONOCOTYLEDONAE

AMARYLLIDACEAE

Amaryllis belladonna *L.*, Forestry 1984

Brunsvigia minor *Lindl.*, T 11301

Cyrtanthus angustifolius (*L.f.*) *Aiton*, Forestry 1984

Gethyllis

spiralis (*Thunb.*) *Thunb.*, Forestry 1984

spp., *Boucher* 2048, T 12254

Haemanthus

coccineus *L.*, *Viviers* 136

crispus *Snijman*, *Salter* 7523

sanguineus *Jacq.*, *Esterhuysen* 20041, *Snijman* 433

Hessea monticola *Snijman*, T 11510

Nerine

humilis (*Jacq.*) *Herb.*, *Pocock* (PRE 30286), T 11738

laticoma (*Ker Gawl.*) *T.Durand & Schinz*, T 8449

sarniensis (*L.*) *Herb.*, *Marsh* 51

ARACEAE

Zantedeschia aethiopica (*L.*) *Spreng.*, Taylor sight records Kliphuis and Pilaarsberg

ASPARAGACEAE

Myrsiphyllum

asparagoides (*L.*) *Willd.*, T 028.A

fasciculatum (*Thunb.*) *Oberm.*, T 8492, 10942

kraussianum *Kunth*, T 11006

multituberosum (*R.A.Dyer*) *Oberm.*, *Obermeyer* 1984

ovatum (*T.M. Salter*) *Oberm.*, T 11874

Protoparagus

aethiopicus (*L.*) *Oberm.*, T 11666, 12064

capensis (*L.*) *Oberm.*, T 10943

compactus (*T.M. Salter*) *Oberm.*, T 11500

lignosus (*Burm.f.*) *Oberm.*, *Haynes* 1203, *Viviers* 1312

retrofractus (*L.*) *Oberm.*, T 10996

rubicundus (*P.J.Bergius*) *Oberm.*, PRECIS 1990

suaveolens (*Burch.*) *Oberm.*, T 10981, 11529

ASPHODELACEAE

Aloe

glauca *Mill.*, *Van Jaarsveld* 4504

khamiensensis *Pillans*, T 10948

mitriformis *Mill.*, T 10916

Bulbine

diphylla *Schr. ex Poelln.*, Bond & Goldblatt 1984

favosa (*Thunb.*) *Roem. & Schult.*, Forestry 1984

flexicaulis *Baker*, Bond & Goldblatt 1984

minima *Baker*, T 11028

torta *N.E.Br.*, *Esterhuysen* 20466, *Kerfoot* 5969, T 129.48

tuberosa (*Mill.*) *Oberm.*, T 11512

Bulbinella

cauda-felis (*L.f.*) *T.Durand & Schinz*, *Barker* 300, *Esterhuysen s.n.* (NBG 83376)

divaginata *P.L.Perry*, *Perry* 3105

elata *P.L.Perry*, *Esterhuysen* 5295

graminifolia *P.L.Perry*, *H. Bolus s.n.* (BOL 32606)

latifolia *Kunth*, *Viviers* 622

nutans (*Thunb.*) *T.Durand & Schinz*, *Perry* 3250

punctulata *Zahlbr.*, *Perry* 3173

triquetra (*L.f.*) *Kunth*, *Esterhuysen* 20564, *Forsyth* 148, *Galpin* 11121, *Pocock* 156, T 11957

Caesia contorta (*L.f.*) *T.Durand & Schinz*, T 10863

Chlorophyllum

pauciphyllum *Oberm.*, Bond & Goldblatt 1984

undulatum (*Jacq.*) *Oberm.*, T 5086

Kniphofia uvaria (*L.*) *Oken*, Bond & Goldblatt 1984

Trachyandra

hirsutiflora (*Adamson*) *Oberm.*, *Barker* 4699, *Compton* 16200

jaquiniana (*Roem. & Schult.*) *Oberm.*, *Stokoe* (SAM 55875)

muricata (*L.f.*) *Kunth*, *Esterhuysen* 8143, *Levyns* 7214

paniculata *Oberm.*, *Macowan* 1985

patens *Oberm.*, *Schlechter* 10791

revoluta (*L.*) *Kunth*, Forestry 1986

COLCHICACEAE

Androcymbium cuspidatum *Baker*, Bond & Goldblatt 1984

Onixotis punctata (*L.*) *Mabberley*, T 11780

Wurmbea minima *B.Nord.*, Bond & Goldblatt 1984

CYPERACEAE

Carpa

bracteosa *C.B.Clarke*, *Arnold* 1002

glomerata (*Thunb.*) *Nees*, *Compton* 6944

Chrysithrix junciformis *Nees*, Bond & Goldblatt 1984

Cyperus

denudatus *L.f.*, T 10872

longus *L.*, T 11200, 11202

marginatus *Thunb.*, T 11148

sphaerospermus *Schrad.*, T 11199, 11203

tenellus *L.f.*, PRECIS 1990

Epischoenus

adnatus *Levyns*, PRECIS 1990

cernuus *Levyns*, *Esterhuysen* 17982

dregeanus (*Boeck.*) *Levyns*, T 11286, 11300, 11701

gracilis *Levyns*, T 11687

Ficinia

acuminata (*Nees*) *Nees*, T 11077, 11111

angustifolia (*Schrad.*) *Levyns*, *Esterhuysen* 12214

brevifolia *Nees ex Kunth*, T 11375, 11549

bulbosa (*L.*) *Nees*, T 11392

capillifolia (*Schrad.*) *C.B.Clarke*, Bond & Goldblatt 1984

capitella (*Thunb.*) *Nees*, T 11366

cedarbergensis *T.H.Arnold & Gordon-Gray*, T 8472, 8489, 10585, 10911, 11248

deusta (*P.J.Bergius*) *Levyns*, T 8490

dunensis *Levyns*, T 8543, 11595

fascicularis *Nees*, T 11402

filiformis (*Lam.*) *Schrad.*, T 11664

gydomontana *T.H.Arnold*, *Esterhuysen* 18053, R

indica (*Lam.*) *Pfeiff.*, T 5112, 5127, 10479, 11066, 11343, 11898

involuta *Nees*, T 5115

ixioides *Nees*, T 10592, 11374

lucida *C.B.Clarke*, Bond & Goldblatt 1984

mucronata *C.B.Clarke*, Bond & Goldblatt 1984

negrescens (*Schrad.*) *J.Raynal*, T 10564, 10565, 10951

oligantha (*Steud.*) *J.Raynal*, *Arnold* 1004, *Esterhuysen* 18050

secunda (*Vahl*) *Kunth*, T 5082

tenuifolia *Kunth*, T 7487a

sp., T 10586, 11373

sp. nov. (= *Esterhuysen* 27008), T 11402, 11618

sp. nov., T 10767, 11651

Fuirena hirsuta (*P.J.Bergius*) *P.L.Forbes*, T 10891

Isolopsis

antarctica (*L.*) *Roem. & Schult.*, *Esterhuysen* 12060

digitata *Schrad.*, T 7449, 12243

fluitans (*L.*) *R.Br.*, T 11167

hystrix (*Thunb.*) *Nees*, Bond & Goldblatt 1984

marginata (*Thunb.*) *A.Dietr.*, T 9276

natans (*Thunb.*) *A.Dietr.*, PRECIS 1990

prolifer *R.Br.*, Taylor sight record, Taai Boschkraal stream

rubicunda *Kunth*, T 11151

tenuissima (*Nees*) *Kunth*, PRECIS 1990

Macrochaetium

ecklonii (*Nees*) *Levyns*, T 10838, 11714

hexandrum (*Nees*) *Pfeiff.*, Bond & Goldblatt 1984, Forestry 1984

Mariscus thunbergii (*Vahl*) *Schrad.*, PRECIS 1990

Scirpus dioecus (*Kunth*) *Boeck.*, PRECIS 1990

Tetraria

bolusii *C.B.Clarke*, T 11525

compar (*L.*) *T.Lestib.*, T 11388

crinifolia (*Nees*) *C.B.Clarke*, PRECIS 1990, T 97.14, 882.7, 886.3

cuspidata (*Routb.*) *C.B.Clarke*, T 7493, 11492, 11505, 11776

ferruginea *C.B.Clarke*, Bond & Goldblatt 1984

graminifolia *Levyns*, *Le Maitre* 200

involuta (*Routb.*) *C.B.Clarke*, T 8482

Tetraria (cont.)

- ligulata C.B.Clarke, T 7486a, 11286, 11491
 maculata Schönland & Turrill, Bond & Goldblatt 1984
 nigrovaginata (Nees) C.B.Clarke, T 8467, 10921
 picta (Boeck.) C.B.Clarke, Bond & Goldblatt 1984
 pubescens Schönland & Turrill, T 5101, 11702
 triangularis (Boeck.) C.B.Clarke, T 8477
 ustulata (L.) C.B.Clarke, T 10920
 vaginata Schönland & Turrill, Bond & Goldblatt 1984
 sp. nov., T 11230, 11698, 11712, 11945
 sp. nov., T 11241

DIOSCOREACEAE

- Dioscorea elephantipes (L'Hér.) Engl., T 10781, 10945

ERIOSPERMACEAE

Eriospermum

- aphyllum Marloth, Leopoldt 4231
 capense (L.) Thunb., Esterhuysen 21132
 flavum P.L.Perry, Perry MS
 graminifolium A.V.Duthie, Esterhuysen 13875, 25555a
 lanceifolium Jacq., A.R. Mitchell 476
 lanuginosum Jacq., T 11397
 cf. nanum Marloth, T 10929
 paradoxum (Jacq.) Ker Gawl., Esterhuysen (NBG 2502/34)
 patentiflorum Schltr., Schlechter 10794, U
 proliferum Baker, Bruyns 2368, Perry 3098
 pumilum T.M.Salter, Perry 1991
 cf. pustulatum Marloth ex A.V.Duthie, Wagener 71
 spirale (L.) P.J.Bergius, T 9587
 subincanum P.L.Perry, Perry 1026
 subtile P.L.Perry, Perry 1991

HAEMODORACEAE

- Dilatrix ixioideis Lam., T 10473, 11685

Wachendorfia

- laxa W.F.Barker MS, T 11090, 11141, 11376
 paniculata Burm., T 11822

HYACINTHACEAE

Albuca

- cf. altissima Dryand., Forestry 1986
 cf. canadensis (L.) F.M.Leighton, Forestry 1984
 cooperi Baker, T 6158a, 11852
 massonii Baker, Bond & Goldblatt 1984

Lachenalia

- aloides (L.f.) Engl., Barnes (BOL 21936), Barker 3060
 bolusii W.F.Barker, Bond & Goldblatt 1984
 elegans W.F.Barker, T 11853
 esterhuyseniae W.F.Barker, Bond & Goldblatt 1984, U
 hirta (Thunb.) Thunb., Nordenstam & Lundgren 2029
 margaretae W.F.Barker, Bond & Goldblatt 1984, U
 marginata W.F.Barker, Bond & Goldblatt 1984
 maximiliani Schltr. ex W.F.Barker, Bond & Goldblatt 1984
 mutabilis Sweet, Forestry 1984
 orchioideis (L.) Aiton, Bond & Goldblatt 1984
 pusilla Jacq., Müller-Doblies 80132b, T 12120
 unicolor Jacq., Barker 3059, Leopoldt (BOL 20785), T 9326
 ventricosa Schltr. ex W.F.Barker, Bond & Goldblatt 1984

Massonia echinata L.f., PRECIS 1990

Neobakeria heterandra F.M.Leighton, Esterhuysen 21370, Pocock 11116

Ornithogalum

- conicum Jacq., Bond & Goldblatt 1984, Taylor colour slide 173/30
 dubium Houtt., T 10616
 fimbri-marginatum F.M.Leighton, T 11137
 graminifolium Thunb., Stokoe 7321
 maculatum Jacq., T 10616, 11088
 nanodes F.M.Leighton, Esterhuysen 17959
 suaveolens Jacq., T 6165
 subcoriaceum L.Bolus, Kruger 918
 thysoides Jacq., T 11887
 xanthochlorum Baker, Bond & Goldblatt 1984

Rhadamanthus

- convallarioides (L.f.) Baker, Salter 5025
 montanus B.Nord., Esterhuysen 7423, 22474
 platyphyllus B.Nord., Esterhuysen 18135

Tenicroa filifolia (Jacq.) Oberm., Compton 12730, Gouws 202

Urginea pusilla (Jacq.) Baker, Bond & Goldblatt 1984

Whiteheadia bifolia (Jacq.) Baker, Bond & Goldblatt 1984

HYPOXIDACEAE

Spiloxene

- aquatica (L.f.) Fourc., Stokoe (SAM 55739)
 capensis (L.) Garside, T 11901, 1
 minuta (L.) Fourc., T 5109
 schlechteri (Bolus) Garside, T 5105
 umbraticola (Schltr.) Garside, PRECIS 1990, U
 sp. (Spiloxinella MS), T 11869

IRIDACEAE

Aristea

- africana (L.) Hoffmanns., PRECIS 1990
 cuspidata Schinz, PRECIS 1990
 dichotoma (Thunb.) Ker Gawl., T 6191, 11709
 monticola Goldblatt, Le Maître 624, T 12090
 singularis Weim., T 11009, R
 Babiana
 ambigua (Roem. & Schult.) G.J.Lewis, T 11011
 auriculata G.J.Lewis, Bond & Goldblatt 1984, R
 cedarbergensis G.J.Lewis, Bond & Goldblatt 1984, R
 crispa G.J.Lewis, Bond & Goldblatt 1984
 disticha Ker Gawl., Forestry 1984
 mucronata (Jacq.) Ker Gawl., Bond & Goldblatt 1984

Bobartia

- fasciculata J.B.Gillert ex Strid, Oliver et al. 1983, U
 rufa Strid, T 10803

Chasmanthe floribunda (Salisb.) N.E.Br., Bond & Goldblatt 1984

Ferraria ferrariola (Jacq.) Willd., Bond & Goldblatt 1984

Freesia occidentalis L.Bolus, Goldblatt 4069

Galaxia

- citrina G.J.Lewis, Esterhuysen 8104, 13033
 luteoalba Goldblatt, Goldblatt 2205
 ovata Thunb., Goldblatt 3878
 stagnalis Goldblatt, Goldblatt 3883

Geissorhiza

- aspera Goldblatt, T 11126, 11802
 bolusii Baker, T 11636
 cedarmontana Goldblatt, Bond & Goldblatt 1984
 ciliatula Goldblatt, Bond & Goldblatt 1984
 confusa Goldblatt, T 1839, 10765, 11143
 erubescens Goldblatt, Bond & Goldblatt 1984
 juncea (Link) A.Dietr., Bond & Goldblatt 1984
 minuta Goldblatt, Bond & Goldblatt 1984
 ornithogaloideis Klatt, Bond & Goldblatt 1984
 parva Baker, Bond & Goldblatt 1984
 scillaris A.Dietr., Bond & Goldblatt 1984
 sulphurascens Schltr. ex R.C.Foster, T 12080
 unifolia Goldblatt, Bond & Goldblatt 1984

Gladiolus

- alatus L., Barker 2001, Lewis (BOL 22268)
 angustus L., T 1849
 buckerveldii (L.Bolus) Goldblatt, Delpierre & Du Plessis 1973, R
 carinatus Aiton, T 1651
 caryophyllaceus (Burm.f.) Poir., T 10703
 delpierrei Goldblatt, Bond & Goldblatt 1984, R
 floribundus Jacq., Wagener 280
 hyalinus Jacq., Lewis (BOL), Stokoe (SAM 55659)
 inflatus Thunb., T 10587, 10649, 11765, 1
 liliaceus Houtt., T 1624, 7444
 odoratus L.Bolus, Lewis 6140, Salter 8137
 oreocharis Schltr., Esterhuysen 7551, 15020, T 1864, R
 pillansii G.J.Lewis, T 11305
 pritzelii Diels, Primos 11709, T 6147
 scullyi Baker, Lewis 5221, Salter 3631, Wagener 141
 tristis L., T 1844, 10496
 undulatus L., Forestry 1984, Taylor sight record Slangvlei (& colour slide)
 uysiae L.Bolus ex G.J.Lewis, Wagener 206
 violaceo-lineatus G.J.Lewis, Esterhuysen 5920, Horrocks 94, R
 Gynandris cedarmontana Goldblatt, Bond & Goldblatt 1984
 Hesperantha
 bachmannii Baker, Goldblatt 229
 cedarmontana Goldblatt, Esterhuysen 3192, Goldblatt 7120, Kerfoot 5964
 elsiae Goldblatt, Esterhuysen 17966
 falcata (L.f.) Ker Gawl., Goldblatt 6399, Oliver 4019

Hesperantha (cont.)

- pilosa* (L.f.) Ker Gawl., *Barker* 261, *Esterhuysen* 13141, *Goldblatt* 5134
radiata (Jacq.) Ker Gawl., *Acocks* 2216, *Esterhuysen* 7232, *T* 11900

Homeria

- bifida* L.Bolus, Bond & Goldblatt 1984
cedarmontana Goldblatt, Bond & Goldblatt 1984, R
cookii L.Bolus, Bond & Goldblatt 1984
flavescens Goldblatt, Bond & Goldblatt 1984
miniata (Andrews) Sweet, Forestry 1984
ochroleuca Salisb., *T* 10643, 11547
patens Goldblatt, Bond & Goldblatt 1984, R
tenuis Schltr., Bond & Goldblatt 1984

Ixia

- capillaris* L.f., *Esterhuysen* 3184
flexuosa L., *Thode* A2138
latifolia D.Delaroche, *T* 1850
paniculata D.Delaroche, *Thode* 2139
pauciflora G.J.Lewis, *Barker* 3781, *Wagener* 140
paucifolia G.J. Lewis, *Compton* 9702, *Esterhuysen* 12153
polystachya L., PRECIS 1990
rapunculoides D.Delaroche, PRECIS 1990
scillarlis L., PRECIS 1990

Lapeirousia

- divaricata* Baker, *Bolus* 9100, *MacOwan* 1975
fabriicii (D.Delaroche) Ker Gawl., *Goldblatt* 9502
jacquinii N.E.Br., *Barker* 1309
micrantha (E.Mey. ex Klatt) Baker, *Goldblatt* 5150

Melasphaerula ramosa (L.) N.E.Br., Bond & Goldblatt 1984, Taylor sight records

Micranthus

- alopeuroides* (L.) Rothm., PRECIS 1990
juncus (Baker) N.E.Br., Forestry 1984
tubulosus (Burm.f.) N.E.Br., *Pocock* 586, 805

Moraea

- angusta* (Thunb.) Ker Gawl., *Pocock* 328
anomala G.J.Lewis, *T* 11834
barkeriae Goldblatt, Goldblatt 1986, R
ciliata (L.f.) Ker Gawl., *T* 11013
crispa Thunb., Goldblatt 1986
fugax (D.Delaroche) Jacq., Goldblatt 1986
gawleri Spreng., Goldblatt 1986
gracilentia Goldblatt, Goldblatt 1986
inconspicua Goldblatt, Goldblatt 1986
macrocarpa Goldblatt, Goldblatt 1986
macronyx G.J.Lewis, *Viviers* 471
neglecta G.J.Lewis, Goldblatt 1986
papilionacea (L.f.) Ker Gawl., Goldblatt 1986
pseudospicata Goldblatt, Goldblatt 1986
ramosissima (L.f.) Druce, Goldblatt 1986
tricuspidata (L.f.) G.J.Lewis, Goldblatt 1986
tripetala (L.f.) Ker Gawl., Goldblatt 1986
unguiculata Ker Gawl., Goldblatt 1986

Rheome maximiliani (Schltr.) Goldblatt, Bond & Goldblatt 1984

Romulea

- atrandra* G.J.Lewis, *T* 5106
cedarbergensis De Vos, De Vos 2030, *Esterhuysen* 8043, *Stokoe* (SAM 63691), U
flava (Lam.) De Vos, De Vos 2043, *Stokoe* (SAM 63695)
hirta Schltr., *Schlechter* 8766
leipoldtii Marais, De Vos 1466, *MacOwan* (SAM 20725)
luteoflora (De Vos) De Vos, *Barnes* (BOL 19471), De Vos 2031
minutiflora Klatt, De Vos 1647, 2032
montana Schltr. ex Bég., *Schlechter* 8648, I8847
rosea (L.) Eckl., *Barker* 261, *Esterhuysen* 8042, 21754
saxatilis De Vos, *Esterhuysen* 12171, *T* 11021
schlechteri Bég., *Malan* (STE 30313), *Schlechter* 8648
stellata De Vos, *T* 11321
sulphurea Bég., *Schlechter* 10818, X
tabularis Eckl. ex Bég., *Marloth* 2658
triflora (Burm.f.) N.E.Br., *Stokoe* (SAM 68325)
vinacea De Vos, *Barker* 6591, De Vos 1921, *Leipoldt* (BOL 21278), R
viridibracteata De Vos, De Vos 1668, *Salter* 3652, U

Sparaxis variegata (L.Bolus) Goldblatt, Barker 4700, Wisura 1754

Syringodea longituba (Klatt) Kunze, De Vos 2208

Thereanthus

- bracteolatus* (Lam.) G.J.Lewis, *Schlechter* 9765
juncifolius (Baker) G.J.Lewis, *T* 11482

Tritonia

- crispa* (L.f.) Ker Gawl., *Middlemost* 1910, *Thode* A2181
parvula N.E.Br., *Esterhuysen* 18009

Tritoniopsis

- antholyza* (Poir.) Goldblatt, *T* 11659, 11684
latifolia G.J.Lewis, *T* 10915, R
longituba (Fourc.) Goldblatt, *Compton* 6308, *Esterhuysen* 25524
nemorosa (E.Mey. ex Klatt) G.J.Lewis, *Viviers* 8
nervosa (Baker) G.J.Lewis, *T* 6205, 10874
parviflora (Jacq.) G.J.Lewis, *Thode* A2783
ramosa (Eckl. ex Klatt) G.J.Lewis, *Viviers* 142

Watsonia

- angusta* Ker Gawl., *T* 11218, 12121
fourcadei J.W.Mathews & L.Bolus, Goldblatt 1989
marginata (L.f.) Ker Gawl., *T* 11679
meriana (L.) Mill., PRECIS 1990
stokoei L.Bolus, *T* 11723
vanderspuyiae L.Bolus, *T* 11860

JUNCACEAE

Juncus

- bufonius* L., PRECIS 1990
capensis Thunb., *T* 11713
effusus L., *T* 11206
lomatophyllus Spreng., *T* 8480a, 10873, 11951

Prionium serratum (L.f.) Drege ex E.Mey., Bond & Goldblatt 1984, Taylor sight records

ORCHIDACEAE

Ceratandra globosa Lindl., Compton 12746, T 12255

Corycium

- crispum* (Thunb.) Sw., *Lewis* 5226
deflexum (Bolus) Rolfe, *Bolus* 8660, *Wagener* 229

Disa

- atricapilla* (Harv. ex Lindl.) Bolus, *T* 11615, 12221
caulescens Lindl., Bond & Goldblatt 1984
cedarbergensis H.P.Linder, *Linder* 4462
draconis (L.f.) Sw., *T* 1625, 12247
elegans Sond. ex Rchb.f., *Linder* 1645, *Pocock* 594
esterhuyseniae Schelpe ex H.P.Linder, Bond & Goldblatt 1984
filicormis (L.f.) Thunb., *T* 11162
lineata Bolus, Bond & Goldblatt 1984
ovalifolia Sond., *Barnes* & *Weintraub* (BOL 19320), *Bodkin* (BOL 9092), R
salteri G.J.Lewis, Bond & Goldblatt 1984, R
telipogonis Rchb.f., Bond & Goldblatt 1984
triloba Lindl., *T* 10827
uncinata Bolus, Bond & Goldblatt 1984
uniflora P.J.Bergius, Forestry 1984
venosa Sw., PRECIS 1990

Disperis

- bolusiana* Schltr. ex Bolus, *Steiner* 714
capensis (L.) Sw., *T* 11769
circumflexa (L.) T.Durand & Schinz, *Barker* 4702, *Lewis* 22271
villosa (L.f.) Sw., Bond & Goldblatt 1984

Herschelianthe

- multifida* (Lindl.) Rauschert, *Linder* 1981b
spathulata (L.f.) Rauschert, *Linder* 1981b

Holothrix

- secunda* (Thunb.) Rchb.f., *T* 11807
villosa Lindl., *Pocock* 609

Monadenia

- bracteata* (Sw.) T.Durand & Schinz, *Linder* 1981a
comosa Rchb.f., *Linder* 1981a

Pterygodium catholicum (L.) Sw., Forestry 1984

Satyrium

- bicorne* (L.) Thunb., *T* 11635
erectum Sw., *T* 10709, 11347
humile Lindl., *T* 11862
pumilum Thunb., *T* 11142

Schizodium

- bifidum* (Thunb.) Rchb.f., PRECIS 1990
inflexum Lindl., *T* 11089

POACEAE

- Aira cupaniana* Guss. *, *T* 7529, 12084
Andropogon appendiculatus Nees, *T* 11725
Anthoxanthum
dregeanum (Nees) Stapf, Bond & Goldblatt 1984
tongo (Trin.) Stapf, *T* 11127

Aristida

- diffusa* Trin., *T* 10815
junciformis Trin. & Ruprecht, Bond & Goldblatt 1984

Cymbopogon marginatus (Steud.) Stapf ex Burtt Davy, Forestry 1984
Cynodon dactylon (L.) Pers., Bond & Goldblatt 1984, De Wet & Harlan 1971

Ehrharta

cf. *brevifolia* Schrad., T 11846
calycina J.E.Sm., T 11576, 11948
capensis Thunb., T 11880
longifolia Schrad., PRECIS 1990
microlaena Nees ex Trin., T 10902
ramosa (Thunb.) Thunb., T 11601, 11632, 11890
thunbergii Gibbs Russ., T 11579
villosa Schult.f., T 10738, 11502, 11577, 11582

Eragrostis

capensis (Thunb.) Trin., T 6186
curvula (Schrad.) Nees, T 10958, 11758
Festuca scabra Vahl, T 5136

Fingerhuthia africana Lehm., T 10582

Holcus setiger Nees, Ellis 5515

Hypparrhenia hirta (L.) Stapf, T 11612

Imperata cylindrica (L.) Raeusch., T relevés 181, 182

Merxmüllera

arundinacea (P.J.Bergius) Conert, T 11027
cincta (Nees) Conert, T 11219
rufa (Nees) Conert, PRECIS 1990
stricta (Schrad.) Conert, T 10742

Paspalum dilatatum Poir. *, T 11727

Pennisetum

macrourum Trin., T 10779
thunbergii Kunth, Thompson 1539

Pentameris

dregeana Stapf, T 11590, 11622
macrocalycina (Steud.) Schweick., T 5131, 10680, 11113

Pentaschistis

airoides (Nees) Stapf, Bond & Goldblatt 1984
alticola H.P.Linder, Esterhuysen 17987
ampla (Nees) McClean, T 11504
aristoides (Thunb.) Stapf, T 11381
barbata (Nees) H.P.Linder, Ellis 2507
colorata (Steud.) Stapf, Acocks 19848, Ellis 2506
curvifolia (Schrad.) Stapf, T 6137, 10773, 11134
densifolia (Nees) Stapf, T 6151, 11899
elegans (Nees) Stapf, Bond & Goldblatt 1984
eriotoma (Nees) Stapf, T 6181, 10826, 11158
glandulosa (Schrad.) H.P.Linder, Esterhuysen 18158
malouinensis (Steud.) Clayton, Bond & Goldblatt 1984
montana H.P.Linder, Esterhuysen 18033, 18155, T 6141
pallescens (Schrad.) Stapf, Ellis 2505
pallida (Thunb.) H.P.Linder, T 7511, 11668
 cf. *pallida* (Thunb.) H.P.Linder, T 12244
patula (Nees) Stapf, Linder 4330
pungens H.P.Linder, Ellis 5791, Esterhuysen 13030, T 5138
pusilla (Nees) H.P.Linder, T 10899
pyrophila H.P.Linder, T 10688, 11067
reflexa H.P.Linder, Ellis 5786
rigidissima Pilg. ex H.P.Linder, T 12230
rosea H.P.Linder, T 11153
rupestris (Nees) Stapf, T 6200, 11503
triseta (Thunb.) Stapf, T 12085
velutina H.P.Linder, T 10468, 11381, 11838
viscidula (Nees) Stapf, T 10817, 11837
 sp., T 5138, 11292

Phragmites australis (Cav.) Steud., Bond & Goldblatt 1984

Poa bulbosa L., PRECIS 1990

Stipagrostis zeyheri (Nees) De Winter, T 10737

Themeda triandra Forssk., Forestry 1984, Taylorsight records, e.g. Amon Track and Taaiboschkraal

Tribolium

brachystachyum (Nees) Renvoize, T 12086
hispidum (Thunb.) Desv., Edwards 160, Esterhuysen 18159A, Le Maitre 303, T 7491, 10525
uniolae (L.f.) Renvoize, T 10719, 11583, 11716

Vulpia

bromoides (L.) Gray *, T 11844
myuros (L.) C.C.Gmel. *, Du Toit 1560, 1732, Spies 3849

RESTIONACEAE

Anthochortus singularis Esterh., Esterhuysen 22436

Askidiosperma

albo-aristatum (Pillans) H.P.Linder, T 10889
capitatum Steud., T 10854

insigne (Pillans) H.P.Linder, Oliver et al. 1983

nitidum (Mast.) H.P.Linder, T 8481, 10515, 11053

paniculatum (Mast.) H.P.Linder, Linder 1985

Calopsis

dura Esterh., Linder 1985

esterhuyseniae (Pillans) H.P.Linder, Linder 1985

marlothii (Pillans) H.P.Linder, T 8475, 10666, 10924, 11041, 11243

paniculata (Rottb.) Desv., T 10998, 12033

rigorata (Mast.) H.P.Linder, T 8488, 10717

virinea (Rottb.) H.P.Linder, T 11263, 11304, 11391, 11395, 11409, 11593

Cannomois

aristata Mast., T 11750, U

congesta Mast., T 5124

nitida (Mast.) Pillans, T 11130

parviflora (Thunb.) Pillans, T 7509a, 8465, 8535, 10564, 10679, 11550, 11647

taylorii H.P.Linder Forsyth 253, Haynes 1548, Linder 4471, T 7534, 8495, 9350, 11717

virgata (Rottb.) Steud., T 5137

Dovea macrocarpa Kunth, Oliver et al. 1983

Elegia

asperiflora (Nees) Kunth, T 11239, 11265, 11279

capensis (Burm.f.) Schelpe, Oliver et al. 1983

esterhuyseniae Pillans, Linder 1985

filacea Mast., T 11246, 11285, 11673, 11711

grandispicata H.P.Linder, Linder 1985

neesii Mast., T 10853

vaginulata Mast., Oliver et al. 1983

Hydrophilus rattrayi (Pillans) H.P.Linder, T 11031

Hypodiscus

argenteus (Thunb.) Mast., T 10730

aristatus (Thunb.) Krauss, Esterhuysen 7848

laevigatus (Kunth) H.P.Linder, T 6827, 10536, 11240

neesii Mast., T 11020, 11037, 11052

cf. *squamosus* Esterh., T 10656

striatus (Kunth) Mast., Oliver et al. 1983

Ischyrolepis

capensis (L.) H.P.Linder, Oliver et al. 1983

curviramis (Kunth) H.P.Linder, T 5128, 10717, 10726, 11030, 11244, 11293, 11382

distracta (Mast.) H.P.Linder, T 11404

fraterna (Kunth) H.P.Linder, Oliver et al. 1983

gaudichaudiana (Kunth) H.P.Linder, T 10924, 11245, 12046, 12050, 12057

gossypina (Mast.) H.P.Linder, T 11656, 11777

laniger (Kunth) H.P.Linder, T 6160, 10690, 11644

macer (Kunth) H.P.Linder, Oliver et al. 1983

marlothii (Pillans) H.P.Linder, Oliver et al. 1983

monanthos (Mast.) H.P.Linder, T 8544, 10918, 11264

nana Esterh., T 11115, 12049, 12087

ocrea (Kunth) H.P.Linder, T 8458, 8487, 11915

rivula Esterh., Linder 1985

rottoelloioides (Kunth) H.P.Linder, Oliver et al. 1983

setiger (Kunth) H.P.Linder, Linder 1985, U

sieberi (Kunth) H.P.Linder, T 10909, 10926, 11012

unispicata H.P.Linder, T 10655, 10769, 11391a, 11660, 11858

virgea (Mast.) H.P.Linder, T 5090, 8464, 11313

wallichii (Mast.) H.P.Linder, Oliver et al. 1983

Platycaulos compressus (Rottb.) H.P.Linder, T 11745

Restio

arcuatus Mast., Oliver et al. 1983

brachiatus (Mast.) Pillans, Oliver et al. 1983

brunneus Pillans, T 8462a, 10560, 12238, R

confusus Pillans, Oliver et al. 1983

cymosus (Mast.) Pillans, T 8463a, 11059

distichus Rottb., Oliver et al. 1983

filiformis Poir., T 10591, 10692, 10977, 11059, 11070, 11475

insignis Pillans, Oliver et al. 1983

miser Kunth, Oliver et al. 1983

occultus (Mast.) Pillans, T 11040, 11168

patens Mast., T 8455, 10689, 11032, 11751

pedicellatus Mast., T 5104, 11133

perplexus Kunth, T 11688, 11851, 12041, 12044, 12048, 12052

praeacutus Mast., Oliver et al. 1983

quinquefarius Nees, Linder 1985

strobilifer Kunth, T 5094, 5125, 6825, 10632

triticeus Rottb., Oliver et al. 1983

tuberculatus Pillans, Oliver et al. 1983, U

Rhodocoma capensis Nees ex Steud., Oliver et al. 1983

Staberoha

aemula (Kunth) Pillans, T 6830, 10852

Staberoha (cont.)

- cernua (L.f.) T.Durand & Schinz, Linder 1985
 distachyos (Rottb.) Kunth, Linder 1985, Oliver et al. 1983
 ornata Esterh., Linder 1985
 vaginata (Thunb.) Pillans, T 7445

Thamnochorus

- acuminatus Pillans, T 5102, 10691
 bachmannii Mast., T 10624, 11876
 platypteris Kunth, T 10724, 11291, 11328, 11596
 schlechteri Pillans, T 8534

Willdenowia

- arescens Kunth, T 7490, 10707, 10716, 10721, 11051, 11383, 11470, 11756
 glomerata (Thunb.) H.P.Linder, T 8459, 8533, 10617, 11247, 11362
 humilis Mast., Linder 1985
 incurvata (Thunb.) H.P.Linder, T 10627, 10966, 11214
 stokoei Pillans, T 5107, 11649, 11764, 11778
 sulcata Mast., T 5130, 11699

TECOPHILAEACEAE

Cyanella hyacinthoides L., Forestry 1984

XYRIDACEAE

Xyris capensis Thunb., T 10837

ANGIOSPERMAE-DICOTYLEDONAE

AIZOACEAE

Acrosanthes

- anceps (Thunb.) Sond., Adamson 1959
 angustifolia Eckl. & Zeyh., T 6197, 7487a, 11189, 11220, 11733
 humifusa (Thunb.) Sond., T 11231, 11613
 microphylla Adamson, Bond & Goldblatt 1984

Adenogramma

- glomerata (L.f.) Druce, T 10660
 lichtensteiniana (Schult.) Druce, Bond & Goldblatt 1984
 mullugo Rchb.f., Forestry 1984

Galenia africana L., Bond & Goldblatt 1984, Taylor sight record Bak-makrersfontein

Limeum africanum L., T 10659

Pharnaceum

- dichotomum L.f., Forestry 1984
 elongatum (DC.) Adamson, T 11338
 incanum L., Esterhuysen 12052, 21917
 lanatum Bartl., Emdon 113
 rubens Adamson, Bond & Goldblatt 1984
 serpyllifolium L.f., Bond & Goldblatt 1984

Polypoda capensis Presl, Bond & Goldblatt 1984

Psammotropha

- anguina Compton, T 10481, 10699
 diffusa Adamson, Bond & Goldblatt 1984
 frigida Schltr., T 12262
 quadrangularis (L.f.) Fenzl, Kruger 923, T 7448, 11166

Tetragonia

- fruticosa L., G.J.Lewis 4173
 hirsuta L.f., T 11336
 nigrescens Eckl. & Zeyh., T 10991, 11336a
 rosea Schltr., T 10940
 saligna Fenzl, T 12122

ANACARDIACEAE

Heeria argentea (Thunb.) Meisn., PRECIS 1990

Rhus

- angustifolia L., T 7532
 cuneifolia L.f., T 11182
 dissecta Thunb., T 755, 1643, 5068
 incisa L.f., T 10574
 rimosa Eckl. & Zeyh., T 1642, 8448, 10739, 11251
 rosmarinifolia Vahl, T 10786
 scytophylla Eckl. & Zeyh., T 1644, 1652, 8457, 9342
 tormentosa L., T 11450
 undulata Jacq., T 5073

APIACEAE

Anginon paniculatum (Thunb.) B.L.Burt, T 11271

Annesorrhiza sp., T 11492

Arctopus echinatus L., T 5099

Centella

- affinis (Eckl. & Zeyh.) Adamson, T 11731
 fusca (Eckl. & Zeyh.) Adamson, Esterhuysen 18015, 18159, 18175
 glabrata L., T 7503

lasiophylla Adamson, Bond & Goldblatt 1984

linifolia (L.f.) Druce, T 11357, T 11412

cf. recticarpa Adamson, T 11811, 11884

cf. restioides Adamson, Stirton & Zantovska 11496

scabra Adamson, T 5070, 5087, 8499

cf. sessilis Adamson, Stirton & Zantovska 11480

villosa L., T 11691, 11813, 11866

virgata (L.f.) Druce, Stirton 11632

sp., T 6138

Conium sphaerocarpaceum Hilliard & B.L.Burt, Esterhuysen 18107

Hermas

ciliata L.f., Taylor sight records, Sneecuberg

gigantea L.f., PRECIS 1990

intermedia C.Norman, Bond & Goldblatt 1984

Itasina filifolia (Thunb.) Raf., T 11870, 11886

Lichtensteinia trifida Cham. & Schltdl., Taylor fragment coll. Kliphuis gully

Peucedanum

multiradiatum Druce, T 11024

sonderi (Hiroe) B.L.Burt, T 10740, 11024

strictum (Spreng.) B.L.Burt, T 11227, 12027

Polemanniopsis marlothii (H.Wolff) B.L.Burt, T 11268, 11448, 11729, 11817

AQUIFOLIACEAE

Ilex mitis (L.) Radlk., Forestry 1984

ASCLEPIADACEAE

Asclepias

cancellata Burn.f., Forestry 1984

crispa P.J.Bergius, T 11931

Cynanchum africanum R.Br., Maguire 1025, Compton 19996

Microloma

sagittatum (L.) R.Br., PRECIS 1990, T 11003

tenuifolium (L.) K.Schum., PRECIS 1990, T 10790

Secamone alpini Schult., Forestry 1984

Stapelia

arenosa C.A.Lück., Bond & Goldblatt 1984

cedrimontana Frandsen, Bond & Goldblatt 1984

erectiflora N.E.Br., Compton et al. (NBG 1371/48), Rossouw 209, Wagener (NBG 218/43), R

grandiflora Masson, Bond & Goldblatt 1984

Tridentea parvipuncta (N.E.Br.) L.C.Leach, Bond & Goldblatt 1984

ASTERACEAE

Arctotheca calendula (L.) Levyns, PRECIS 1990

Arctotis

acaulis L., PRECIS 1990

adpressa DC., Compton 5070, 9585, Kerfoot 6149

angustifolia L., T 11399

aspera L., T 11743, 11906

diffusa Thunb., T 10756

laevis Thunb., T 10471, 10761

oocephala DC., Compton 9586

pinnatifida Thunb., T 11499

semipapposa (DC.) Beauverd, T 11159, 11585

undulata Jacq., L.E.Taylor 2920

venusta Norl., Forestry 1984

Athanasia

bremeri Källersjö, T 7478, 10527

calophylla Källersjö, Esterhuysen 26886, T 11709

flexuosa Thunb., T 10771, 10933, 11169, 11680

linifolia Burn., T 11408

microphylla DC., Andrag 183, T 11256, 11524

pachycephala DC., T 10503, 10847, 11930, 12220, Viviers 813

trifurcata (L.) L., T 10772

Athrixia crinita (L.) Druce, Bond & Goldblatt 1984

Atrichantha gemmifera (Bolan) Hilliard & B.L.Burt, Bond & Goldblatt 1984

Berkheya

barbata (L.f.) Hutch., PRECIS 1990

dregei Harv., Andrag 78, U

tysonii Hutch., T 11933

viscosa (DC.) Hutch., Compton 20949

Brachylaena nerifolia (L.) R.Br., Bond & Goldblatt 1984, Taylor relevé 20

Bryomorpha lycopodioides (Sch.Bip.) Levyns, Compton 6187, T 12261

Castalis nudicaulis (L.) Norl., T 8538, 10634, 11589

Cenia turbinata (L.) Pers., Maguire 244

Chrysanthemoides monilifera (L.) Norl., T 12174

Chrysocoma

candelabrum E.Bayer, Esterhuysen 2488, 30018

Chrysocoma (cont.)

cernua L., *Esterhuysen* 20521

ciliata L., T 11570, 11718

cf. ciliata L., T 11091

longifolia DC., *Adamson* D73

Cineraria

alchemilloides DC., *Esterhuysen* 18101canescens Wendl. ex Link, *Esterhuysen* 18152erosa (Thunb.) Harv., *Viviers* 812

pedunculosa DC., Bond & Goldblatt 1984

Conyza scabrida DC., *Wagener* 310

Corymbium

africanum L., T 10903

congestum E.Mey. ex DC., *Haynes* 1275, *Leipoldt* 3664, *Weitz* 364glabrum L., *Andrag* 200, *Barker* 857, *Esterhuysen* 17977, T 10903laxum *Compton*, T 10892villosum L.f., *Weitz* 356

Cotula

barbata DC., *Compton* 9536leptalea DC., *Forestry* 1984melaleuca Bolus, *Esterhuysen* 8065, 12278montana *Compton*, *Esterhuysen* 7325, 7548

Cullumia

bisulca (Thunb.) Less., T 11035

ciliaris (L.) R.Br., *Maguire* 1835

Dicoma picta (Thunb.) Druce, Bond & Goldblatt 1984

Didelta spinosa (L.f.) Aiton, T 10941

Dimorphotheca

montana Norl., T 11553

pluvialis (L.) Moench, *Barker* 6583sinuata DC., *Pocock* 236

Dolichothrix ericoides (Lam.) Hilliard & B.L.Burt, T 8450, 11740

Edmondia pinifolia (Lam.) Hilliard, Bond & Goldblatt 1984

Elytropappus

adpressus Harv., T 11513

cyathiformis DC., T 11424

glandulosus Less., T 11747

gnaphaloides (L.) Levyns, T 11469, 11736, 12073

cf. gnaphaloides (L.) Levyns, T 11188

rhinocerotis (L.f.) Less., T 12055

scaber (L.f.) Levyns, T 11746, 12026, 12032, 12056, 12066, 12068, 12070

Eriocephalus

africanus L., T 10566, 10963

punctulatus DC., Bond & Goldblatt 1984

sp., *Haynes* 1379

Euryops

abrotanifolius (L.) DC., *PRECIS* 1990brevilobus *Compton*, Bond & Goldblatt 1984, R

lateriflorus (L.f.) DC., T 8526, 30.23

multifidus (Thunb.) DC., *Compton* 6911, *Wagener* 115

othonnoides (DC.) B.Nord., T 10964

rehmannii *Compton*, *Esterhuysen* 20455, *Wagener* 99speciosissimus DC., *Forestry* 1984, *Taylor* V1.74.1tagetoides (DC.) B.Nord., *Kruger* 917

tenuissimus (L.) DC., T 10474, 10671

thunbergii B.Nord., *Barker* 6579wagneri *Compton*, T 10670

Felicia

aethiopica (Burm.f.) Bolus & Wolley-Dod ex Adamson & T.M.Salter, T 7460

amoena (Sch.Bip.) Levyns, Bond & Goldblatt 1984

australis (Alston) E.Phillips, *Esterhuysen* 8064, *Wagener* 175

bellidioides Schltr., Bond & Goldblatt 1984

cymbalariae (Aiton) Bolus & Wolley-Dod ex Adamson & T.M.Salter, T 5113, 6169, 11400, 11856

diffusa (DC.) Grau, T 11835

dregel DC., T 10572

dubia Cass., *Esterhuysen* 3290, 8137, 13135ferulacea *Compton*, T 5121, 11075

filifolia (Vent.) Burt Davy, T 7477, 10580, 11875

hirsuta DC., *Esterhuysen* 4394

hispidula (DC.) Grau, T 11929

merxmulleri Grau, *Leipoldt* (BOL 20793)minima (Hutch.) Grau, *Esterhuysen* 13016, 20554

scabrida (DC.) Range, T 10662

tenella (L.) Nees, T 9317

Gazania serrata DC., T 10715

Gorteria personata L., T 9318

Gymnodiscus capillaris (L.f.) DC., T 11393

Haplocarpha

lanata (Thunb.) Less., T 12091

parvifolia (Schltr.) Beauverd, T 11084, 11099, 11555

Helichrysum

acrophilum Bolus, T 11693, 11913, 11927

asperum (Thunb.) Hilliard & B.L.Burt, T 11722

catipes (DC.) Harv., Bond & Goldblatt 1984

cylindriflorum (L.) Hilliard & B.L.Burt, T 10736, 11410, 11658, 11916

dasyanthum (Willd.) Sweet, T 11131, 11354, 11609, 11832

foetidum (L.) Moench, T 12264

hamulosum E.Mey. ex DC., Bond & Goldblatt 1984

hebelepis DC., Bond & Goldblatt 1984

helianthemifolium (L.) D.Don, *Compton* 6185

indicum (L.) Grierson, T 11845

lambertianum DC., T 11962, 12246

moeserianum Thellung, T 11136, 11394, 11949

odoratissimum (L.) Sweet, T 11501, 12242

scabrum Less., T 11545, 11808

stoloniferum (L.f.) Willd., *Pocock* 196

tinctum (Thunb.) Hilliard & B.L.Burt, T 7513, 11426

tomentosulum (Klatt) Merxm., *Forestry* 1984

zeyheri Less., T 10947

sp., T 11812

Heterolepis aliena (L.f.) Druce, T 1840, 11437

Hippia

frutescens (L.) L., T 11078

pilosa (P.J.Bergius) Druce, T 5134

Hirpicium alienatum (Thunb.) Druce, *Acocks* 3215

Hymenolepis

dentata (DC.) Källersjö, T 10598, 11076, 11755

parviflora (L.) DC., C.C.P.Wagener s.n. (STE 26822)

Hypochoeris

glabra L. *, Taylor relevé 150

radicata L. *, Taylor relevés 909-917

Ifloga ambigua (L.) Druce, T 10984, 12054

Lachnospermum

ericoides Willd., T 11468

fasciculatum (Thunb.) Baill., T 10913

Lamprocephalus montanus B.Nord., Bond & Goldblatt 1984

Lasiopogon brachypterus O.Hoffm. ex Zahlbr., *PRECIS* 1990

Leysera gnaphalodes (L.) L., T 9323

Lidbeckia lobata Thunb., T 7447, 10720

Mairia

ecklonis (DC.) Sond., *PRECIS* 1990

lasiocarpa DC., T 11038

microcephala (Less.) DC., T 10641

perezioides Nees, T 11322

Metalasia

agathosmoides Pillans, *Andrag* 245, *Esterhuysen* 22460

albescens Karis, T 11411

densa (Lam.) Karis, T 8536, 11407

dregiana DC., Herre (STEU 11443), *Stokoe* (SAM 61971), T 7497A

fastigiata (Thunb.) D.Don, T 10761, 11355, 11566, 11836

Oedera

genistifolia (L.) Anderb. & Bremer, *Kruger* 925, T 11611multipunctata (DC.) Anderb. & Bremer, *Kruger* 916

sedifolia (DC.) Anderb. & Bremer, T 10885

squarrosa (L.) Anderb. & Bremer, T 11081

Oligothrix gracilis DC., Bond & Goldblatt 1984

Oncosiphon grandiflorum (Thunb.) Källersjö, *Forestry* 1984

Osteospermum

acutifolium (Hutch.) Norl., T 8546, 10470, 10732

bidens Thunb., T 10714, 11419

clandestinum (Less.) Norl., Bolus 9042, *Galpin* 10729, T 9341

connatum DC., T 10482, 10596

imbricatum L., *Forestry* 1986polygaloides L., *Forestry* 1984

rigidum Aiton, T 5066, 10472, 10599, 10780

Othonna

alba *Compton*, *Acocks* 20453

amplexifolia DC., T 1649, 10710, 10970

arbuscula (Thunb.) Sch.Bip., *Leipoldt* 1906

auriculifolia Lich. ex Less., T 10961

coronopifolia L., T 8527

cuneata DC., T 8469

filicaulis Jacq., T 10932

gymnodiscus (DC.) Sch.Bip., T 10985

Othonna (cont.)

- hederifolia B.Nord., T 10960
humilis Schltr., Bond & Goldblatt 1984
lobata Schltr., T 10588, 11766
multicaulis Harv., T 8451, 11281
obtusiloba Harv., Esterhuysen 4882
parviflora P.J.Bergius, T 10501
petiolaris DC., T 10954, 10976
ramulosa DC., Forestry 1984

Polyarrhena imbricata (DC.) Grau, Bond & Goldblatt 1984

Printzia polifolia (L.) Hutch., T 11349

Pteronia

- ambrariifolia Schltr., T 11000
camphorata L., T 7479, 10778, 10887, 11350, 11882
cinerea L.f., T 11335
divaricata (P.J.Bergius) Less., T 11806
fasciculata L.f., Bond & Goldblatt 1984
utilis Hutch., T 11662

Relhania

- calycina (L.f.) L'Hér., T 11914
corymbosa (Bolus) Bremer, T 11117, 11639

Senecio

- albifolius DC., T 11923
amabilis DC., T 11724
angustifolius (Thunb.) Willd., Meyer 8091
arenarius Thunb., T 11396, 11820, 11892
burchellii DC., T 11586
cinerascens Aiton, T 11043
crassulifolius (DC.) Sch.Bip., T 7525, 11367
cymbalariifolius (Thunb.) Less., T 11829
eribasis DC., PRECIS 1990
erosus L.f., T 8539, 11050
glabrifolius DC., T 10789
grandiflorus P.J.Bergius, PRECIS 1990
cf. junceus (DC.) Harv., T 3043
lanceus Aiton, Rycroft 2670
paniculatus P.J.Bergius, T 7516, 10523, 10840, 11961
parvifolius DC., Esterhuysen 20475
pinifolius (L.) Lam., Barker 4503
pinnatifidus (P.J.Bergius) Less., Forestry 1984
pubigerus L., Forestry 1984, T 024.27
repandus Thunb., T 11796
rosmarinifolius L.f., T 10809
sophioides DC., Esterhuysen 12223
tortuosus DC., Esterhuysen 21734, Hugo 555
tuberosus (DC.) Harv., T 10711, 11620
vestitus P.J.Bergius, T 10893, 11840, 11864, 11954

Stilpnogyne bellidioides DC., Bond & Goldblatt 1984

Stoebe

- aethiopica L., T 7462
capitata P.J.Bergius, Forestry 1984, Forestry 1986
fusca (L.) Thunb., T 10919, 12040
intricata Levyns, T 12042, 12045, 12047, 12051, 12058, 12061, 12067, 12069, 12071
leucocephala DC., T 11253
plumosa (L.) Thunb., T 12059
saxatilis Levyns, T 11527, 12028
spiralis Less., T 11298

Syncarpha

- canescens (L.) B.Nord., T 10962
dregeana (DC.) B.Nord., T 11094, 11236, 11416
ferruginea (Lam.) B.Nord., Forestry 1984
flava (Compton) B.Nord., T 10532, 11282
variegata (P.J.Bergius) B.Nord., T 10705, 11083
virgata (P.J.Bergius) B.Nord., T 11420

Troglophyton

- elsiae Hilliard, PRECIS 1990
parvulum (Harv.) Hilliard & B.L.Burt, PRECIS 1990

Ursinia

- anthemoides (L.) Poir., T 7510, 11842
cakilefolia DC., Leopoldt 20798, Lewis 3659
chrysanthemoides (Less.) Harv., T 11019, R
macropoda (DC.) N.E.Br., T 10864
nana DC., PRECIS 1990
nudicaulis (Thunb.) N.E.Br., Bond & Goldblatt 1984
nudicaulis (Thunb.) N.E.Br. × U. palcacea (L.) Moench, T 11418
palcacea (L.) Moench, PRECIS 1990
pilifera (P.J.Bergius) Poir., T 8541, 10701, 10993
pinnata (Thunb.) Prassler, T 10867, 10927

- punctata (Thunb.) N.E.Br., T 10506, 10791, 11938
rigidula (DC.) N.E.Br., PRECIS 1990
sericea (Thunb.) N.E.Br., T 10522, 10743
subflosculosa (DC.) Prassler, Esterhuysen 7150, R

BORAGINACEAE

Anchusa capensis Thunb., Wagener 186

Lobostemon

- echioides Lehm., T 10764, 11348
glaucophyllus (Jacq.) H.Buek, T 5077, 7476, 11665, 11760
hispidus (Thunb.) DC., T 11353, 11572
laevigatus (L.) H.Buek, T 10570, 11587
trichotomus (Thunb.) DC., T 10469

BRASSICACEAE

Brachycarpaea juncea (P.J.Bergius) Marais, T 6155, 10504, 11121, 11209

Cycloptychis

- marlothii O.E.Schultz, Esterhuysen 12716
virgata (Thunb.) E.Mey. ex Sond., T 11210, 11683, 11878

Heliophila

- africana (L.) Marais, Hardy 802
amplexicaulis L.f., T 11578
arenaria Sond., Compton 6849
arenosa Schltr., Esterhuysen 20517
carnosa (Thunb.) Steud., T 10663
cedarbergensis Marais, Esterhuysen 30000, R
cornuta Sond., T 11805
coronopifolia L., Esterhuysen 13112
crithmifolia Willd., T 11843
descurva Schltr., Marais 1420
digitata L.f., Forestry 1984
dregeana Sond., T 11118, 11511, 11584, 11619
elata Sond., Compton 6950, Esterhuysen 7179
latisiliqua E.Mey. ex Sond., Schlechter 8603
namaquana Bolus, Schlechter 8633
pinnata L.f., Schlechter 8636
scoparia Burch. ex DC., T 10600, 11079
seselifolia Burch. ex DC., Marais 1422, Schlechter 8811
Lepidium trifurcum (Sond.) Marais, T 11826
Schlechteria capensis Bolus, T 11368, 11617, 11754, 11904

BRUNIACEAE

Berzelia

- intermedia (D. Dietr.) Schldl., Oliver et al. 1983
lanuginosa (L.) Brongn., T 8483, 10514
squarrosa (Thunb.) Sond., Oliver et al. 1983
Brunia nodiflora L., Oliver et al. 1983

Lonchostoma

- monogynum (Vahl) Pillans, Forestry 1984
pentandrum (Thunb.) Druce, T 10693

Nebelia paleacea (P.J.Bergius) Sweet, Bond & Goldblatt 1984

Pseudobaeckea

- africana (Burm.f.) Pillans, T 4478, 12245
cordata (Burm.f.) Niedenzu, Oliver et al. 1983

Raspalia

- dregeana (Sond.) Niedenzu, Bond & Goldblatt 1984, Oliver et al. 1983
palustris (Schltr. ex Kirchn.) Pillans, T 11106
staavioides (Sond.) Pillans, T 7468, 11544
villosa Presl, T 11642

Thamnea diosmoides Oliv., T 11556

Tittmannia laxa (Thunb.) Presl, T 7849, 10511

CAMPANULACEAE

Lightfootia

- multicaulis Adamson, Bond & Goldblatt 1984, U
cf. spicata H.Buek, T 10774, 10861, 11430, 11703
sp., T 11939

Prismatocarpus

- alpinus (Bond) Adamson, Forestry 1984
brevilobus A.DC., T 11944
cf. brevilobus A.DC., T 11474
decurrens Adamson, Bond & Goldblatt 1984, U
diffusus (L.f.) A.DC., T 11207, 11744
fruticosus L'Hér., T 6192, 10495, 11506, 11689
pauciflorus Adamson, Bond & Goldblatt 1984, U
sp., T 10859

Wahlenbergia

- costata A.DC., Forestry 1986, PRECIS 1990
decipiens A.DC., Pillans 9062
denticulata (Burch.) A.DC., PRECIS 1990
ecklonii H.Buek, T 6164, 11614, 11625, 11920

Wahlenbergia (cont.)

- meyeri A.D.C., Bond & Goldblatt 1984
oxyphylla A.D.C., Forestry 1984
pilosa H.Buek, PRECIS 1990
sphaerica Brehmer, Bond & Goldblatt 1984

CARYOPHYLLACEAE

Dianthus

- albens Aiton, Forestry 1984
bolusii Burt Davy, Compton 6225
thunbergii Hooper, PRECIS 1990

Silene

- burchellii Oth, T 11863
clandestina Jacq., Forestry 1986
undulata Aiton, T 11809

Stellaria media (L.) Vill., T 11825

CELASTRACEAE

- Cassine peragua L., T 8461, 8545, 10995, 11223, 11969
Hartogiella schinoides (Spreng.) Codd, T 10953, 10990, 11793, 11864
Maytenus
 acuminata (L.f.) Loes., T 7455
 oleoides (Lam.) Loes., Forestry 1984
Pterocelastrus tricuspidatus (Lam.) Sond., T 11267, 11700

CONVOLVULACEAE

- Convolvulus capensis Burmf., T 11334
Cuscuta nitida E.Mey. ex Choisy, T 7488

CRASSULACEAE

- Adromischus maculatus (Salm-Dyck) Lem., T 11720
Cotyledon orbiculata L., Bond & Goldblatt 1984
Crassula
 alpestris Thunb., Esterhuysen 3392, 20456
 aphylla Schönland & Baker f., T 10882
 atropurpurea (Haw.) D. Dietr., T 10804, 10805, 10845, 11675, 11708, 11850, 11941
 barbata Thunb., Bond & Goldblatt 1984
 cymosa P.J.Bergius, T 11877
 decumbens Thunb., T 11604
 dejecta Jacq., T 10910, 11186
 dentata Thunb., T 6171, 7528, 11112, 11422, 11855, 12082
 dichotoma L., Forestry 1986
 elsiae Toelken, Bond & Goldblatt 1984, R
 fascicularis Lam., T 11135
 filiformis (Eckl. & Zeyh.) D.Dietr., T 11386
 glomerata P.J.Bergius, Esterhuysen 22481
 lanceolata (Eckl. & Zeyh.) Endl. ex Walp., Bond & Goldblatt 1984
 lasiantha Drège ex Harv., Esterhuysen 21311
 minuta Toelken, Bond & Goldblatt 1984
 montana Thunb., Toelken 1977
 muscosa L., T 10950
 var. obtusifolia (Harv.) G.D. Rowley, T 11721
 nudicaulis L., T 11360
 obtusata Haw., T 11902, 12089
 papillosa Schönland & Baker f., T 5132
 pubescens Thunb., T 11891, 11919
 pustulata Toelken, T 11229
 rupestris Thunb., T 11752, 11804
 saxifraga Harv., Forestry 1984
 sebaeoides (Eckl. & Zeyh.) Toelken, T 11821
 subulata L., Taylor relevé 144
 tetragona L., T 12043
 umbellata Jacq., T 11086, 11602
 umbellata Thunb., T 5132
 sp., T 84
Tylecodon paniculatus (L.f.) Toelken, Taylor sight record Taaiboschkraal

CUNONIACEAE

- Platylophus trifoliatus (L.f.) D.Don, Kruger 910

DIPSACACEAE

- Scabiosa columbaria L., T 11667

DROSERACEAE

Drosera

- alba E.Phillips, Bond & Goldblatt 1984
cistiflora L., T 10700
trinervia Spreng., T 12079

EBENACEAE

Diospyros

- austro-africana De Winter, Bond & Goldblatt 1984
glabra (L.) De Winter, T 10459
ramulosa (E.Mey. ex A.D.C.) De Winter, Andrag 82, T 10939

Euclea

- acutifolia E.Mey. ex A.D.C., T 6196, 7497, 10602
lancea Thunb., T 10997, 11494, 11707, 12065
linearis Zeyh. ex Hiern, T 11968
natalensis A.D.C., Forestry 1984
tomentosa E.Mey. ex A.D.C., T 11867
tomentosa E.Mey. ex A.D.C. × E. natalensis A.D.C., T 10958, 10959

ERICACEAE

- Arachnocalyx viscidus (N.E.Br.) E.G.H.Oliv., Oliver et al. 1983

- Coccosperma areolatum N.E.Br., T 11648, 11921

Eremia

- calycina Compton, Oliver et al. 1983
curvistyla (N.E.Br.) E.G.H.Oliv., Oliver et al. 1983
recurvata Klotzsch, T 6133, 10513, 10897, 11999
totta (Thunb.) D.Don, T 6175, 11830, 12235

Erica

- aemula Guthrie & Bolus, Oliver et al. 1983
alnea E.G.H.Oliv., Esterhuysen 30316
arcuata Compton, T 10930, 11288
articularis L., T 10912, 11287
aspalathoides Guthrie & Bolus, Oliver et al. 1983, U
bergiana L., T 10539, 12260
bicolor Thunb., T 11581
breviflora Dulfer, T 2305, 10505, 11670
bruniades L., Oliver et al. 1983
caffra L., Andrag 291, Oliver 4022
calycina L., T 5133, 7470, 10788, 10825, 11109
cederbergensis Compton, Compton 6296, Esterhuysen 7550
cerinthoides L., Wagener 343
cernua Montin, T 5116, 10695, 11036, 11631
chlamydidiflora Salisb., Oliver et al. 1983
coccinea L., T 10508, 11897
consobrina Guthrie & Bolus, Oliver et al. 1983
copiosa Wendt., Oliver et al. 1983
corifolia L., Oliver et al. 1983
crisiflora Salisb., T 7461, 11125, 11369, 11603, 11690
curviflora L., T 10830, 10928, 11242
daphniflora Salisb., T 45, 6819, 6829, 10497, 10535
denticulata L., Oliver et al. 1983
distorta Bartl., Oliver et al. 1983
doliiformis Salisb., Oliver et al. 1983
eriocodon Bolus, Oliver et al. 1983
eugenea Dulfer, Oliver et al. 1983
flacca E.Mey. ex Benth., Oliver et al. 1983
glauca Andrews, T 11650
gnaphaloides L., Oliver et al. 1983
goatcheriana L. Bolus, Oliver et al. 1983
guthrieae Bolus, Kruger 940
haematosiphon Guthrie & Bolus, T 6177, 10881
hispidula L., T 11371
hispiduloides E.G.H.Oliv., Esterhuysen 34008
humifusa Hibbert ex Salisb., Oliver et al. 1983
imbricata L., Oliver et al. 1983
incarnata Thunb., T 1845, Kruger 930
inflata Thunb., T 44, 2304, 6170, 10509
infundibuliformis Andrews, Oliver et al. 1983
involutrata Klotzsch ex Benth., T 1848
junonia Bolus, Oliver et al. 1983
lavandulifolia Salisb., Oliver et al. 1983
leptopus Benth., T 10857, 10865
leucanthera L.f., T 7472, 11129, 11180
longipedunculata Lodd., T 11184
lucida Salisb., T 10678, 11073, 11370
lutea P.J.Bergius, T 10894, 11481
macrotrema Guthrie & Bolus, Oliver et al. 1983
maderi Guthrie & Bolus, T 5109a, 5142, 7848
mammosa L., Oliver et al. 1983
maximiliani Guthrie & Bolus, T 7852, 10777, Kruger 919
monantha Compton, Oliver et al. 1983
monsoniana L.f., T 5098
nubigena Bolus, T 6153, 11155
nudiflora L., T 6828, 11278, 11297
oresigena Bolus, T 1860, 7854, 10844, 12083
palliiflora Salisb., T 11114, 12225

Erica (cont.)

- parilis Salisb.*, T 9589, 10857
parviflora L., Oliver et al. 1983
penicilliformis Salisb., Oliver et al. 1983
philippoides Compton, Oliver et al. 1983
placentiflora Salisb., T 7517, 10635, 11597, 11818
plukenetii L., T 11641
pseudocalycina Compton, Oliver et al. 1983
pubescens L., Oliver et al. 1983
pudens H.A.Baker, Oliver et al. 1983
quadrangularis Salisb., Oliver et al. 1983
rubens Thunb., T 7458, 10870, 11674, 11965, 12219, 12248
selaginifolia Salisb., T 11571
senilis Klotzsch ex Benth., Kruger 926, T 6163, 7452, 8548, 10475
setociliata H.A.Baker, Oliver et al. 1983
sonderiana Guthrie & Bolus, Oliver et al. 1983
sphaerocephala Wendl. ex Benth., T 11779
subimbricata Compton, Oliver et al. 1983
tenuis Salisb., Oliver et al. 1983
thunbergii Montin, T 11616
transparens P.J.Bergius, Oliver et al. 1983
tumida Ker Gawl., Oliver et al. 1983
vanheurckii Müll.Arg., Oliver et al. 1983
verecunda Salisb., T 8481a, 11299, 11661
 sp. nov. (aff. *argentea Klotzsch ex Benth.*), T 6159, 11294, 11634
 sp. nov. (= *Esterhuysen* 22446), T 11643, 11924
Grisebachia
ciliaris (L.f.) Klotzsch, T 10484, 11025, 11607, 1
parviflora (Klotzsch) Druce, T 5125a, 7459, 8471, 10683, 11033, 11057, 11311
Salaxis
axillaris (Thunb.) G.Don, Bond & Goldblatt 1984
triflora Compton, Oliver et al. 1983
Scyphogyne
divaricata (Klotzsch) Benth., Oliver et al. 1983, T 104.13
muscosa (Aiton) Druce, Oliver et al. 1983
urceolata (Klotzsch) Benth., T 5095, 10971, 11049, 11156
Simocheilus
albarameus N.E.Br., Oliver et al. 1983
bicolor (Klotzsch) Benth., Oliver et al. 1983
glaber (Thunb.) Benth., T 033.6
puberulus (Klotzsch) E.G.H.Oliv., T 5119, 10593, 10664

EUPHORBIACEAE

Clusia

- alaternoides L.*, T 10644
polifolia Jacq., T 5081, 5135, 6162, 7464, 7465, 11008, 10569
polygonoides L., T 10708, 11630, 11814
pulchella L., T 10987
rubricaulis Eckl. ex Sond., Compton 5395, Le Maître 311
 sp. nov. (= *Marloth* 11499), *Esterhuysen* 12265, T 7456, 10731, 11194

Euphorbia

- arceuthobioides Boiss.*, Emdon 119
burmannii E.Mey. ex Boiss., T 9336
erythrina Link., T 94.24
genistoides P.J.Bergius, T 10652
loricata Lam., T 9295
mauritanica L., Taylor relevé 44
tuberosa L., T 10975
 sp. (= *Andrag* 85), *Forestry* 1984

FABACEAE

Aspalathus

- acifera R.Dahlgren, Compton* 6203, *Dahlgren & Strid* 4272, 4474
acocksii (R.Dahlgren) R.Dahlgren, Acocks 15045, *Richardson* 31
acuminata Lam., Oliver et al. 1983
altissima R.Dahlgren, T 7530, 11105, 11149
argyrella MacOwan, Oliver et al. 1983
arida E.Mey., T 11425
aristata Compton, T 11910
aurantiaca R.Dahlgren, Compton 12480, *Leighton* 3343
bidouwensis Garab. ex R.Dahlgren, Oliver et al. 1983
bodkinii Bolus, T 7853, 10477, 10848, 11275
bracteata Thunb., T 6194
brevicarpa (R.Dahlgren) R.Dahlgren, T 11964, 12249
ciliaris L., T 10808, 11179
comptonii R.Dahlgren, Bond & Goldblatt 1984
confusa R.Dahlgren, Oliver et al. 1983
costulata Benth., T 10651, 11574
crenata (L.) R.Dahlgren, Oliver et al. 1983

- cuspidata R.Dahlgren*, T 11431, 11873
decora R.Dahlgren, T 6189, 10524, 11495, U
dianthopora E.Phillips, T 11810
divaricata Thunb., T 7514a, 11140, 11735, 11885
esterhuysenae R.Dahlgren, Oliver et al. 1983
filicaulis Eckl. & Zeyh., Oliver et al. 1983
flexuosa Thunb., Oliver et al. 1983
florulenta R.Dahlgren, Bond & Goldblatt 1984, U
galeata E.Mey., T 7517, 11605, 11682
galeata E.Mey., X A, *triquetra Thunb.*, T 11573, 11621, 11652
heterophylla L.f., Oliver et al. 1983
hirta E.Mey., T 10811
hispida Thunb., T 11940
joubertiana Eckl. & Zeyh., T 10673
laeta Bolus, Bond & Goldblatt 1984
lanata E.Mey., T 7496, 11734
lanceifolia R.Dahlgren, Compton 12706, *Esterhuysen* 18000
lanifera R.Dahlgren, Bond & Goldblatt 1984
linearis (Burm.f.) R.Dahlgren, T 11438, 11439, 11441
nigra L., Oliver et al. 1983
nudiflora Harv., T 11728
pendula R.Dahlgren, T 11440
perfoliata (Lam.) R.Dahlgren, Oliver et al. 1983, T 10831, 11654
pinea Thunb., Oliver et al. 1983
polyccephala E.Mey., T 11562, 11624, 12234
quinquefolia L., T 11174, 11435, 11565
retroflexa L., Oliver et al. 1983
rupestris R.Dahlgren, Bond & Goldblatt 1984, Oliver et al. 1983
sericea P.J.Bergius, T 10806
spicata Thunb., Oliver et al. 1983
spinossissima R.Dahlgren, Oliver et al. 1983
tridentata L., Oliver et al. 1983, T 6161, 7499, 10860, 11935
triquetra Thunb., T 10528, 10828
uniflora L., Bolus 8979
villosa Thunb., T 10869, 11816, 11958
vulnerans Thunb., T 10625
wittebergensis Compton & P.E.Barnes, T 11704
Coelidium
cedarbergensis Granby, T 5110, 10561, 11068, 11774
perplexum (Eckl. & Zeyh.) Granby, *Granby* 231
purpureum Granby, Bond & Goldblatt 1984
villosum (Schltr.) Granby, Bolus 5619, *Esterhuysen* 13077
Cyclopia montana Hofmeyer & E.Phillips, T 11072, 11629
Dipogon lignosus (L.) Verdc., T 11798
Hypocalyptus sophoroides (P.J.Bergius) Baill., T 11893
Indigofera
adenoides Baker f., T 7454
amoena Aiton, T 11002
capillaris Thunb., T 12094
filifolia Thunb., *Forestry* 1984
frutescens L., *Forestry* 1984
gifbergensis C.H.Stirt. & J.K.Jarvie, T 10868, 11847
gracilis Spreng., T 10784
humifusa Eckl. & Zeyh., T 11911
 cf. *intermedia Harv.*, T 11002
psoraloides (Presl) Benth., T 11879
venusta Eckl. & Zeyh., T 11346, 11559
 sp. indet., *Haynes* 1368, T 117.8, 12252
Lebeckia
carnosa (E.Mey.) Druce, T 6193, 10877
cytisoides Thunb., T 11560
grandiflora Benth., T 11626
longipes Bolus, T 11633
pauciflora Eckl. & Zeyh., *Le Maître* 260
simisiana Eckl. & Zeyh., T 11023
Lessertia
capensis (P.J.Bergius) Druce, Bond & Goldblatt 1984
excisa DC., Bond & Goldblatt 1984
herbacea (L.) Druce, T 11138
Lotononis
densa (Thunb.) Harv., T 11569
falcata (E.Mey.) Benth., T 11803
Otholobium
spicatum (L.) C.H.Stirt., *PRECIS* 1990
striatum (Thunb.) C.H.Stirt., *PRECIS* 1990, *D.E.Taylor s.n.*
trianthum (E.Mey.) C.H.Stirt., *PRECIS* 1990
Podalyria
amoena Eckl. & Zeyl., *Leighton* 1248
leipoldtii L.Bolus, Andrag 124, *Esterhuysen* 8138, T 11561
pearsonii E.Phillips, Le Maître 536

Priestleya

coriacea *Granby, Kruger 912, T 7527, 11925*
umbellifera *DC., T 1861, 6174, 11956*
sp., *T 10499*

Psoralea

aphylla *L., PRECIS 1990*
fascicularis *DC., T 10876*
oligophylla *Eckl. & Zeyh., T 10519, 12034*
oreopola *C.H.Stirt., Pocock 418, T 6182, 11970a*
pinnata *L., T 10500, 10521, 10526*
tenuissima *E.Mey., Bond & Goldblatt 1984*
verrucosa *Willd., T 12240*
spp. indet. (genus under revision), *T 10866, 11190, 11215, 11216, 11436, 11715*

Rafnia

amplexicaulis *Thunb., T 11097, 11258, 11432*
capensis *(L.) Druce, T 7506, 10516, 11295*
cuneifolia *Thunb., T 11917*
dichotoma *Eckl. & Zeyh., T 6201*
diffusa *Thunb., T 6136, 10754, 11098, 11145*
meyer *Schinz, T 5931, 11254, 12237*
ovata *(P.J.Bergius) Schinz, T 11160*
perfoliata *E.Mey., Bond & Goldblatt 1984*
retroflexa *Thunb., T 11483*
spicata *Thunb., T 7451, 11405, 11627*
sp., *T 11157*

Rhynchosia

bullata *Benth. ex Harv. & Sond., Esterhuysen 14990, Schlechter 8661, Stirton & Zantovska 11467*
cf. schlechteri *Baker f., T 11759*
sp., *T 11222*
sp. nov., *T 10785*
Spartium junceum *L. *, T 11737*
Sutherlandia frutescens *(L.) R.Br., T 10567*
Tephrosia capensis *(Jacq.) Pers., T 11580*
Wiborgia
fusca *Thunb., Hugo 651*
leptoptera *R.Dahlgren, Bond & Goldblatt 1984*
cf. monoptera *E.Mey., T 10946*
mucronata *(L.f.) Druce, T 11100*
obcordata *(P.J.Bergius) Thunb., T 10955*
sericea *Thunb., Bolus 8976*
tetraptera *E.Mey., T 10733*

FLACOURTIACEAE

Kiggelaria africana *L., T 7481, 10520*

FUMARIACEAE

Cysticapnos

cracca *(Cham. & Schltdl.) Liden, T 11827*
vesicarius *(L.) Fedde, T 11801*

GENTIANACEAE

Chironia

arenaria *E.Mey., Bond & Goldblatt 1984, Forestry 1984*
baccifera *L., T 6832*
linoides *L., T 11217, 11225*

Sebaea

aurea *(L.f.) Roem. & Schult., T 6188*
exacoides *(L.) Schinz, Forestry 1986*
pusilla *Eckl. & Cham., Forestry 1984*

GERANIACEAE

Erodium moschatum *(L.) L'Hér. ex Aiton *, Weintraub J19303, J19388*

Pelargonium

abrotanifolium *(L.f.) Jacq., Kruger 921*
alpinum *Eckl. & Zeyh., Bond & Goldblatt 1984*
alternans *Wendl., T 11871*
angustifolium *(Thunb.) DC., Marais 268*
caespitosum *Turcz., PRECIS 1990, Hugo 1201*
carnosum *(L.) L'Hér., Van der Walt 746*
chamaedryfolium *Jacq., Le Maître 545, 618*
coronopifolium *Jacq., T 7450, 10766, 11087, 11096, 11414, 12253*
echinatum *(Thunb.) Curtis, T 5930, Wisura 1739*
ellaphiae *E.M.Marais, Marais 193, Van der Walt 1520*
englerianum *R.Knuth, T 6183, 10782, 11314, 11497, 11653, 12239, 12241*
gracilipes *R.Knuth, Leipoldt 517*
grandiflorum *(Andrews) Willd., T 11888*
laevigatum *(L.f.) Willd., Beyers 112, Van Wyk 1499*
leipoldtii *R.Knuth, Alice & Godman 575*
longicaule *Jacq., Baker 8132, Boucher 58*

longiflorum *Jacq., Le Maître s.n. (STEU)*

longifolium *(Burm.f.) Jacq., Compton 16776, Lewis 1171*
magentum *J.J.A. van der Walt, Davis (SAM 63206), Schonken 83*
myrrhifolium *(L.) L'Hér., Esterhuysen 3383, 20519, 20541, Hugo 430, 544, T 11588*
nanum *L'Hér., Esterhuysen 20518*
oenothera *(L.f.) Jacq., Pillans 9178, Van der Walt 744*
oreophilum *Schltr., Bond & Goldblatt 1984*
pinnatum *(L.) L'Hér., Esterhuysen 25492*
proliferum *(Burm.f.) Steud., Esterhuysen 15015, 18166, 18172*
rapaceum *(L.) L'Hér., Compton 6253, Marais 196, T 11208*
scabrum *(Burm.f.) L'Hér., T 6198, 10467*
spatulatum *(Andrews) DC., T 11213*
sublignosum *R.Knuth, T 7500*
tabulare *(Burm.f.) L'Hér., T 7519*
triphyllum *Jacq., Esterhuysen 14338, 18020, 18111, T 11953*
triste *(L.) L'Hér., T 11857*
sp., *T 6203*
sp. (Hoarea), *T 10886, 10914*

GRUBBIACEAE

Grubbia rosmarinifolia *P.J.Bergius, Bond & Goldblatt 1984*

HALORAGACEAE

Gunnera perpensa *L., Forestry 1984, Taylor sight records*
Lauremburgia repens *P.J. Bergius, T 12263*

LAMIACEAE

Mentha longifolia *(L.) L., T 10534, 11484*

Salvia

africana-caerulea *L., T 10626*
africana-lutea *L., T 11004, 11800*
albicaulis *Benth., T 6195, 7502, 10494, 11489*
chamelaeagnea *P.J.Bergius, Codd 1985*
dentata *Aiton, Bond & Goldblatt 1984*
lanceolata *Lam., T 10949*

Stachys

aethiopica *L., Bond & Goldblatt 1984*
linearis *Burch. ex Benth., T 10466*
rugosa *Aiton, Emdon 164, Esterhuysen 8131, Schlieben & Van Breda 9884*

LENTIBULARIACEAE

Utricularia bisquamata *Schrank, PRECIS 1990*

LINACEAE

Linum

adustum *E.Mey. ex Planch., Lewis 1902*
comptonii *Rogers, Esterhuysen 2495*
pungens *Planch., T 6166, 11883*

LOBELIACEAE

Cyphia

bulbosa *(L.) P.J.Bergius, T 11029*
dentata *E.Wimm., Bond & Goldblatt 1984*
digitata *(Thunb.) Willd., T 5122, 10590, 11015*
ranunculifolia *E.Wimm., Bond & Goldblatt 1984, R*
volubilis *(Burm.f.) Willd., T 11831*

Laurentia arabidea *(Prest) A.D.C., T 10898*

Lobelia

capillifolia *(Prest) A.D.C., T 10805, 11212, 11932*
comptonii *E.Wimm., Bond & Goldblatt 1984*
coronopifolia *L., T 11226*
erinus *L., Bond & Goldblatt 1984*
esterhuyseniae *E.Wimm., Esterhuysen 21941*
humifusa *(A.D.C.) P.B.Phillipson ined., T 10783*
linearis *Thunb., T 10805, 10814*

Monopsis

acrodon *E.Wimm., T 12092*
debilis *(L.f.) Prest, PRECIS 1990*
flava *(Eckl. & Zeyh.) E.Wimm., Stirton 10169, Thompson 167, U*

LOGANIACEAE

Buddleja

saligna *Willd., Taylor relevé 20, T 32.24, 32.129, 33.85*
salviifolia *(L.) Lam., T 10999*

MALVACEAE

Anisodonteia

bryoniifolia *(L.) D.M.Bates, Barker 780*
gracilis *D.M.Bates, Wagener 302, U*

MELIANTHACEAE

Melianthus major L., Bond & Goldblatt 1984, Taylor sight records

MENISPERMACEAE

Cissampelos capensis L.f., Forestry 1984

MESEMBRYANTHEMACEAE

Cephalophyllum loreum (L.) Schwantes, Barker (NBG 2461/34)

Conophytum

leipoldtii N.E.Br., Esterhuysen s.n.

minusculum (N.E.Br.) N.E.Br., T 11485

Diplosoma retroversum (Kensit) Schwantes, Leipoldt s.n.

Dorotheanthus

bellidiformis (Burn.f.) N.E.Br., Van Jaarsveld 4326

leipoldtii L.Bolus, Leipoldt (BOL 18737)

Erepsia

aspera (Haw.) Schwantes, T 11249, 11681, 11692

bracteata (Aiton) Schwantes, T 84.18

distans L.Bolus, T 11238

saturata L.Bolus, T 11259

sp., T 11748

Lampranthus

argenteus (L.Bolus) L.Bolus, T 10768, 10884

berghiae (L.Bolus) L.Bolus, T 10622

capillaceus (L.Bolus) N.E.Br., PRECIS 1990

cedarbergensis (L.Bolus) L.Bolus, T 11677

comptonii (L.Bolus) N.E.Br., T 7463, 11110, 11164, 11480, 11637

edwardsiae (L.Bolus) L.Bolus, T 11128

guthrieae (L.Bolus) N.E.Br., T 10668

laetus (L.Bolus) L.Bolus, T 10507, 10757, 10883, 11139, 11385, 11519

lunatus (Willd.) N.E.Br., T 8478

lunulatus (A.Berger) L.Bolus, T 10589, 11356, 11671

macrostigma L.Bolus, T 11250, 11266

parvus N.E.Br., T 11695

scaber (L.) N.E.Br., T 8479

staminodiosus (L.Bolus) Schwantes, T 10855

thermarum (L.Bolus) L.Bolus, T 11637

tulbaghensis (A.Berger) L.Bolus, T 10669

sp., T 11434

Ruschia

(= *Antimima*) *microphylla* (Haw.) Schwantes, T 11018

aspera L.Bolus, T 10994

bina L.Bolus, T 10647, 10677, 10956, 11063

cedarbergensis L.Bolus, T 10974

dasyphylla (Schltr.) Schwantes, T 10674, 11320

decurrens L.Bolus, T 11317, 11868

dichroa (Rolf.) L.Bolus, T 10727, 10972, 11165, 11315, 11753

drepanophylla (Schltr. & A.Berger) L.Bolus, Bond & Goldblatt 1984

fredericii (L.Bolus) L.Bolus, T 11413, 11592

lapidicola L.Bolus, Esterhuysen 12031, 21720

lineolata (Haw.) Schwantes, T 10478

minutifolia L.Bolus, H.Hall 2829

pakhuisensis L.Bolus, Bolus (BOL 20749)

solida (L.Bolus) L.Bolus, T 11676

tardissima L.Bolus, T 10579, 10980, 11363, 11493

tumidula (Haw.) Schwantes, T 8473

sp., T 8474, 11541

Skiatophytum tripolium (L.) L.Bolus, Viviers s.n.

MONTINIACEAE

Montinia caryophyllacea Thunb., T 10571

MORACEAE

Ficus cordata Thunb., T 372

MYRICACEAE

Myrica

integra (A.Chev.) Killick, Bond & Goldblatt 1984

serrata Lam., Bond & Goldblatt 1984

MYRSINACEAE

Myrsine africana L., PRECIS 1990

MYRTACEAE

Metrosideros angustifolia (L.) J.E.Sm., PRECIS 1990

OLEACEAE

Jasminum glaucum (L.f.) Aiton, T 10578, 11205

Olea

capensis L. subsp. *capensis*, Bond & Goldblatt 1984, Taylor sight records

europaea L. subsp. *africana* (Mill.) P.S.Green, Bond & Goldblatt 1984, Taylor sight records

OXALIDACEAE

Oxalis

adpersa Eckl. & Zeyh., Leipoldt (BOL 19690)

amblyosepala Schltr., Leipoldt (BOL 18617, 21066)

argillacea F.Bolus, Leipoldt 426

aridicola T.M.Salter, Bayer 4802

aurea Schltr., Bayer 2818

commutata Sond., Bodkin (BOL 14582), Salter 6404, Weintroub (BOL 21867)

dines Ornduff, Bond & Goldblatt 1984, U

dregei Sond., Compton 9554

ebracteata Savign., Salter 733

eckloniana Presl, Barker 4486, Salter 8134

flava L., T 8494

giftbergensis T.M.Salter, Salter 2133, 8128, 8143

gracilipes Schltr., Leipoldt 294

hirta L., Leipoldt (BOL 19672)

livida Jacq., Salter 2135, 8140

minuta Thunb., Bolus 9400

monophylla L., Salter 4436, 8142

obtusata Jacq., T 11014, 11771, 11797, 12231

oreophila T.M.Salter, Salter 5397, U

petiolulata F.Bolus, Adamson (BOL 20492)

phloxidiflora Schltr., Schlechter 10797

porphyriosiphon T.M.Salter, Salter 2454, 5399, U

recticaulis Sond., Salter 3645

stokoei Weintroub, Salter 5084

tenella Jacq., Barker 4487, Salter 8139, T 10934

uliginosa Schltr., Bolus 20976

PLUMBAGINACEAE

Limonium longifolium (Thunb.) R.A.Dyer, T 10792

POLYGALACEAE

Muraltia

acicularis Harv., Oliver et al. 1983

alopecuroides (L.) DC., T 6135, 11277, 11289

angulosa Turcz., T 11122

brachyceras Schltr., T 8485

commutata Levyns, Oliver et al. 1983

crassifolia Harv., Bond & Goldblatt 1984

heisteria (L.) DC., Oliver et al. 1983

horrida Diels, Bond & Goldblatt 1984

lignosa Levyns, Stokoe (SAM 54493)

obovata DC., T 8500

pauciflora (Thunb.) DC., Levyns 5815

pillansii Levyns, Oliver et al. 1983

rhammoides Chod., T 5076, 8542, 10645, 10763, 11380, 11522

scoparia (Eckl. & Zeyh.) Levyns, Shaw (BOL 6036)

sp., T 12236

Nylandtia spinosa (L.) Dumort., Forestry 1984

Polygala

brachyphylla Chod., T 5143a, 6202, 11908

bracteolata L., PRECIS 1990

garcinii DC., T 11606

lehmanniana Eckl. & Zeyh., Esterhuysen 15369, 18164, T 5069

ludwigiana Eckl. & Zeyh., Bond & Goldblatt 1984

pappeana Eckl. & Zeyh., Levyns 8116, 9362

peduncularis Burch. ex DC., Pillans 7085

refracta DC., Bond & Goldblatt 1984

POLYGONACEAE

Persicaria serrulata (Lag.) Webb & Moq., T 5072

Rumex cordatus Poir., Barnes s.n., Le Roux 2609

PROTEACEAE

Aulax pallasia Stapf, T 10537

Brabejum stellatifolium L., Bond & Goldblatt 1984, T 29.34, 31.94, 32.18

Leucadendron

arcuatum (Lam.) I.Williams, T 6157, 10518

bonum I.Williams, T 7846, E

brunioides Meisn., T 11273

concaum I.Williams, T 10702, R

dubium (H.Buek ex Meisn.) E.Phillips & Hutch., Kruger 943, T 6156, 10480, 11926

glaberrimum (Schltr.) Compton, T 10658, 11344, 11594

loranthifolium (Salisb. ex Knight) I.Williams, Kruger 944, T 11340

nitidum H.Buek ex Meisn., T 1858, 1859, 10562, 10694, 10850, 11523

procerum (Salisb. ex Knight) I.Williams, T 11792

pubescens R.Br., Kruger 935, T 7505a

rubrum Burn.f., Oliver et al. 1983

Leucadendron (cont.)

- salignum *P.J.Bergius*, T 5084
 spissifolium (*Salisb. ex Knight*) *I.Williams*, T 11520
 Leucospermum
 calligerum (*Salisb. ex Knight*) *Rourke*, T 10538
 catherinae *Compton*, Oliver et al. 1983, R
 praemorsum (*Meisn.*) *E.Phillips*, Forestry 1984
 reflexum *H.Buek ex Meisn.*, Oliver et al. 1983
 spatulatum *R.Br.*, *Kruger* 934, T 7851, 11150, 11478, 11640
 tottum (*L.*) *R.Br.*, T 11183
 vestitum (*Lam.*) *Rourke*, T 2307, 7475, 10801

Paranomus

- bracteolaris *Salisb. ex Knight*, T 6180, 7522, 10458
 tomentosus (*E.Phillips & Hutch.*) *N.E.Br.*, T 6172, R

Protea

- acaulos (*L.*) *Reichard*, T 5097, 10723, 10775, 10776
 acuminata *Sims*, T 5140, 8491, 11521
 cryophila *Bolus*, T 752, 6826
 cynaroides (*L.*) *L.*, Bond & Goldblatt 1984
 glabra *Thunb.*, Bond & Goldblatt 1984
 laevis *R.Br.*, T 5101a
 laurifolia *Thunb.*, Oliver et al. 1983
 magnifica *Link.*, Forestry 1984
 nitida *Mill.*, Oliver et al. 1983
 pendula *R.Br.*, T 10931, 11773
 piscina *Rourke*, Bond & Goldblatt 1984
 punctata *Meisn.*, T 750, 6823
 recondita *H.Buek ex Meisn.*, T 11742
 repens (*L.*) *L.*, Bond & Goldblatt 1984
 revoluta *R.Br.*, Bond & Goldblatt 1984
 scolopendriifolia (*Salisb. ex Knight*) *Rourke*, T 1847, 5100
 witzenbergiana *E.Phillips*, T 5134, 6822

Serruria

- aitonii *R.Br.*, T 6176, 7446, 7847, 10476, 11085
 cygnea *R.Br.*, T 5078, 6134, 7482, 10832, 11120
 effusa *Rourke*, T 11017, 11706
 flava *Meisn.*, T 5928, 8501, 10485, R
 fucifolia *Salisb. ex Knight*, Oliver et al. 1983
 leipoldtii *E.Phillips & Hutch.*, T 10787, 11175, 11669, R
 millefolia *Salisb. ex Knight*, T 10628

- Sorocephalus lanatus (*Thunb.*) *R.Br.*, *Kruger* 929, T 6158, 7850, 10512, 11107, 11628

Spatalla

- caudata (*Thunb.*) *R.Br.*, Oliver et al. 1983
 confusa (*E.Phillips*) *Rourke*, *Kruger* 937
 incurva (*Thunb.*) *R.Br.*, T 5111, 6167, 10502, 10684, 11108

RANUNCULACEAE

- Anemone tenuifolia (*L.f.*) *DC.*, T 11517

- Knowltonia vesicatoria (*L.f.*) *Sims*, Bond & Goldblatt 1984, Taylor sight record Leipoldt's Grave

RHAMNACEAE

Phylca

- aemula *Schltr.*, T 5088, 10563, 11060
 alticola *Pillans*, Forestry 1984
 altigena *Schltr.*, Bond & Goldblatt 1984, U
 ambigua *Sond.*, T 6179, 7467, 8470, 10741, 12218
 barbata *Pillans*, Bond & Goldblatt 1984, U
 barnardii *Pillans*, T 7469, 11046, 11080
 constricta *Pillans*, Bond & Goldblatt 1984
 cryptandroides *Sond.*, T 6817, 8502, 8524, 10734
 cylindrica *Wendl.*, *Emdon* 122, T 11191
 fruticosa *Schltr.*, T 11103, 11770, R
 hirta *Pillans*, *Diels* 825
 imberbis *P.J.Bergius*, PRECIS 1990
 insignis *Pillans*, Bond & Goldblatt 1984
 leipoldtii *Pillans*, T 10533, 11255, 11272, U
 marlothii *Pillans*, Bond & Goldblatt 1984
 maximiliani *Schltr.*, *Schlechter* 8660, U
 nervosa *Pillans*, Bond & Goldblatt 1984
 odorata *Schltr.*, Bond & Goldblatt 1984
 oleifolia *Vent.*, T 1505, 8456
 plumigera *Pillans*, Bond & Goldblatt 1984, R
 pulchella *Schltr.*, T 8498, 10637, 11342
 rigida *Eckl. & Zeyh.*, T 11104
 rigidifolia *Sond.*, T 6831, 8496, 10577, 10637, 10982
 spicata *L.f.*, Forestry 1984
 stipularis *L.*, T 6818, 12030
 tuberculata *Pillans*, Bond & Goldblatt 1984

- villosa *Thunb.*, T 5074, 6816, 7514, 10925, 11359, 11473

RORIDULACEAE

- Roridula dentata *L.*, T 8486, 11010

ROSACEAE

- Acaena latebrosa *Aiton*, *H.Bolus* 8991

Cliffortia

- amplexistipula *Schltr.*, Bond & Goldblatt 1984
 baccans *Harv.*, T 10661
 dregeana *Presl*, T 6173, 10685
 hantamensis *Diels*, Bond & Goldblatt 1984
 hexandra *Weim.*, T 11283, 11498
 neglecta *Schltr.*, T 8453, 11646
 cf. neglecta *Schltr.*, T 11645
 polygonifolia *L.*, Taylor relevé 75
 propinqua *Eckl. & Zeyh.*, T 5123
 ruscifolia *L.*, T 10640
 sericea *Eckl. & Zeyh.*, T 11065
 strobilifera *Murray*, T 33.29
 teretifolia *L.f.*, T 7515, 10642
 tricuspidata *Harv.*, Bond & Goldblatt 1984
 triloba *Harv.*, T 7483, 10978, 11064
 tuberculata (*Harv.*) *Weim.*, T 5092, 10846
 uncinata *Weim.*, *Pocock* 737, T 6139, 11296
 Rubus rigidus *Sm.*, *Pillans* 9064

RUBIACEAE

Anthospermum

- aethiopicum *L.*, T 11026, 11152, 11406
 bergianum *Cruse*, T 10687, 11389
 bicornis *Puff*, Puff 1986
 comptonii *Puff*, Puff 1986
 dregei *Sond.*, Puff 1986
 esterhuysenianum *Puff*, Puff 1986
 galioides *Rchb.f.*, T 11678
 hirtum *Cruse*, T 7512
 spatulatum *Spreng.*, Puff 1986

Carpacoe

- scabra (*Thunb.*) *Sond.*, Puff 1986, *Pocock* 689
 vaginellata *T.M.Salter*, T 7518, 11390

- Galium capense *Thunb.*, T 6184, 7485, 11507, 11610

Nenax

- coronata *Puff*, Puff 800902-6/4
 divaricata *T.M.Salter*, *Esterhuysen* 8145

RUTACEAE

Acmadenia

- bodkinii (*Schltr.*) *Srid.*, T 7473, 8454, 8466
 flaccida *Eckl. & Zeyh.*, T 5080, 7501, 10967
 macradenia (*Sond.*) *Dummer*, Bond & Goldblatt 1984, R
 matroosbergensis *E.Phillips*, Bond & Goldblatt 1984
 patentifolia *I.Williams*, Bond & Goldblatt 1984, R
 rourkeana *I.Williams*, T 10681
 teretifolia (*Link.*) *E.Phillips*, T 5089a, 6824, 11741

Adenandra

- marginata (*L.f.*) *Roem. & Schult.*, T 11351, R
 villosa (*P.J.Bergius*) *Licht. ex Roem. & Schult.*, Oliver et al. 1983

Agathosma

- adnata *Pillans*, T 10842, 11163, R
 aemula *Schltr.*, T 11095, 11554
 alpina *Schltr.*, PRECIS 1990
 asperifolia *Eckl. & Zeyh.*, T 10969
 bathii (*Dummer*) *Pillans*, Bond & Goldblatt 1984
 betulina (*P.J.Bergius*) *Pillans*, T 11074, 11508, 11591
 bicolor *Dummer*, T 10713, 11815, R
 bifida (*Jacq.*) *Bartl. & Wendl.*, T 10849
 bisulca (*Thunb.*) *Bartl. & Wendl.*, T 10581, 11421, 11732
 bodkinii *Dummer*, T 7457
 capensis (*L.*) *Dummer*, T 10775, 11048, 11119, 11161, 12251
 cedrimontana *Dummer*, T 11429
 conferta *Pillans*, T 10878, R
 craspedota *Sond.*, Bond & Goldblatt 1984
 crassifolia *Sond.*, Bond & Goldblatt 1984
 dentata *Pillans*, Bond & Goldblatt 1984, R
 distans *Pillans*, T 11854, R
 divaricata *Pillans*, *Kruger* 913, T 11638, 11749
 dregeana *Sond.*, PRECIS 1990
 esterhuysenae *Pillans*, Bond & Goldblatt 1984
 giftbergensis *E.Phillips*, T 7486
 humilis *Sond.*, *Esterhuysen* 12146, 12211

Agathosma (cont.)

- juniperifolia Bartl., Esterhuysen 13138
 krakadouwensis Dummer, T 11144
 longicornu Pillans, T 7505, 11047
 marlothii Dummer, T 6168, 7531, 10824
 microcalyx Dummer, T 10986, Van Wyk 2552
 odoratissima (Moutin) Pillans, Bond & Goldblatt 1984
 pattisoniae Dummer, Bond & Goldblatt 1984, U
 peglerae Dummer, Forestry 1984
 pubigera Sond., T 8549, 11039, 11546, 11557
 rubricaulis Dummer, T 11034
 salina Eckl. & Zeyh. ex Pillans, Bond & Goldblatt 1984, R
 serpyllacea Licht. ex Roem. & Schult., Levyns 2192
 sladeniana P.E. Glover, Bond & Goldblatt 1984
 spinescens Dummer, Bean 1350, Esterhuysen 14982
 squamosa (Roem. & Schult.) Bartl. & Wendl., Bond & Goldblatt 1984
 stiboeoides Dummer, T 1648, 1862, 10888, 10901, 11739, 12232
 virgata (Lam.) Bartl. & Wendl., Stokoe (SAM 68824)
 sp., T 11016

Coleonema juniperinum Sond., T 11600

Diosma

- acmacophylla Eckl. & Zeyh., T 5120, 11316, 11526
 hirsuta L., T 8525, 11623
 meyeriana Spreng., T 10629, 11252, 11472, 11533, 11719
 pedicellata I. Williams, Oliver et al. 1983, U
 ramosissima Bartl. & Wendl., T 10577, 11467
 sp. near meyeriana Spreng., T 10923, 11211, 11224, 11290, 11488, 11490
 Empleurum unicapsulare (L.f.) Skeels, Andrag 91, Spreeth 103, Wagener
 362

Euchaetis

- elsiae I. Williams, Oliver et al. 1983
 ericoides Dummer, Esterhuysen 13079, 18032
 esterhuyseniae I. Williams, Oliver et al. 1983, R
 flexilis Eckl. & Zeyh., Forestry 1984
 glomerata Bartl. & Wendl., T 5129, 6820a, 6833, 7488, 11062
 linearis Sond., Forestry 1984

Macrostylis

- decipiens E.Mey. ex Sond., T 8468, 10922
 ramulosa I. Williams, T 10620, R
 squarrosa Bartl. & Wendl., T 8497, 10575, 10735, 11358, 11657, 11730
 tenuis E.Mey. ex Sond., T 10862, 11428, 11528, 11705

Phyllosma capensis Bolus, Kruger 915, T 11102

Sheilanthera pubens I. Williams, Williams 2122

SALICACEAE

Salix mucronata Thunb., T 11799, 12038

SANTALACEAE

Colpoen compressum P.J. Bergius, Bond & Goldblatt 1984, Taylor relevé
20

Thesium

- aggregatum A.W.Hill, Esterhuysen 12266, Leipoldt 3336, Levyns 7248
 capituliflorum Sond., T 11943
 carinatum DC., T 5108, 5143, 8476, 10558, 10665, 11361
 densiflorum A.DC., T 10722
 ericifolium A.DC., Esterhuysen 7340, 7489
 hispidulum Lam., T 10621, 10725, 10762
 juncifolium DC., T 7521
 macrostachyum A.DC., Forestry 1984
 nudicaule A.W.Hill, T 10704, 10758
 oresigenum Compton, T 1647, 5091, 8452, 8476a
 prostratum A.W.Hill, Bond & Goldblatt 1984
 pubescens DC., T 5067, 7509
 selaginum A.DC., T 5141
 spinulosum A.DC., Le Maître 523
 strictum P.J. Bergius, Bond & Goldblatt 1984, Taylor sight records Pak-
 huis Pass
 subnudum Sond., T 10759, 10989
 virgatum Lam., T 5085
 sp. nov., T 11819, 11824

SAPINDACEAE

Dodonaea angustifolia L.f., Andrag 54, Low 688

SCROPHULARIACEAE

Alectra

- sessiliflora (Vahl) Kuntze, PRECIS 1990
 sp., T 11950

Bartsia trixago L., T 11146

Buchnera glabrata Benth., T 11516

Diascia

- elongata Benth., Steiner 2217
 gracilis Schltr., Steiner 2218
 humilis K.E. Steiner, Esterhuysen 20469
 sp., Steiner 2025
 sp., 'long-spurred' (K.E. Steiner MS), Steiner 715, 2014

Freylinia lanceolata (L.f.) G. Don, Metelerkamp 279

Halleria

- elliptica Thunb., T 11192, 11970, 12025
 lucida L., T 11487
 ovata Benth., T 11794

Harveya

- bodkinii Hiern, T 11696
 purpurea Harv., T 12250
 squamosa (Thunb.) Steud., Barker 1019
 sulphurea Hiern, Compton 6893

Hemimeris montana L.f., T 11767

Hyobanche

- atropurpurea Bolus, Levyns 2234, 2531
 sanguinea L., Van Jaarsveld 4506
 Ixianthes retzioides Benth., Andrag 302
 Limosella africana Glueck, Pocock (PRE 41011)

Manulea

- adenocalyx Hilliard, Hilliard 1990
 adenodes Hilliard, Esterhuysen 23760
 altissima L.f., Hilliard 1990
 annua (Hiern) Hilliard, Maguire 1811
 arabidea Schltr., Hilliard 1990
 cephalotes Thunb., Hilliard 1990
 decipiens Hilliard, Hilliard 1990
 glandulosa E. Phillips, Hilliard 1990
 juncea Benth., Hilliard 1990
 laxa Schltr., T 11379
 leiostachys Benth., Hilliard 1990
 montana Hilliard, L.E. Taylor 2964
 paucibarata Hilliard, Compton 6878, 7747, 7748
 pillansii Hilliard, Hilliard 1990
 praeterita Hilliard, Hilliard 1990
 rigida Benth., T 10904
 virgata Thunb., Hilliard 1990

Nemesia

- bodkinii Bolus, Kruger 931, T 11928
 cheiranthus E.Mey. ex Benth., Forestry 1984
 diffusa Benth., T 10594
 ligulata E.Mey. ex Benth., T 8540, 11387
 macroceras Schltr., Forestry 1986
 psammophila Schltr., Thode A2129
 versicolor E.Mey. ex Benth., Forestry 1984

Oftia africana (L.) Bocquet, Forestry 1984

Phyllopodium

- caespitosum Hilliard, Esterhuysen 20574
 cordatum (Thunb.) Hilliard, Compton 7016
 micranthum (Schltr.) Hilliard, Schlechter 8817
 pubiflorum Hilliard, Esterhuysen 3363

Polycarena

- aemulans Hilliard, Salter 7515
 aurea Benth., PRECIS 1990
 exigua Hilliard, Esterhuysen 20575
 formosa Hilliard, Lewis 3864
 gilioides Benth., Compton 4773, 4991
 gracilis Hilliard, Steyn 400
 leipoldtii Hiern, PRECIS 1990
 rariflora Benth., Esterhuysen 20538
 tenella Hiern, Bond & Goldblatt 1984

Sutera

- aethiopica (L.) Kuntze, PRECIS 1990
 caerulea (L.f.) Hiern, Leipoldt (BOL 20218)
 decipiens Hilliard, Esterhuysen 21745
 foetida (Andrews) Roth, Hilliard 1991
 hispida (Thunb.) Druce, T 132.43
 paniculata Hilliard, T 10952
 subsessilis Hilliard, Esterhuysen 18117
 uncinata (Derouss.) Hilliard, Bos 616
 violacea (Schltr.) Hiern, Middlemost 2032

Teedia

- lucida Rudolphi, T 1863
 pubescens Burch., Pocock 580, Thode A2129

Triceneae

- elsiae Hilliard, Esterhuysen 13866
 glutinosa (Schltr.) Hilliard, T 12088
 lanciloba Hilliard, Pocock 653, T 11983, 12029, 12224, 12226
 lasiocephala Hilliard, Esterhuysen 30016
 laxiflora Hilliard, Esterhuysen 14972, T 7471
 schlechteri (Hiern) Hilliard, T 7523, 12081
 taylorii Hilliard, T 11401, 11894, Viviers 595
 Zaluzianskya
 capensis (L.) Walp., Viviers 347
 divaricata Walp., Schlechter 8638
 glandulosa Hilliard, Esterhuysen 21737
 peduncularis (Benth.) Walp., Esterhuysen 20567
 pusilla (Benth.) Walp., Esterhuysen 20549

SELAGINACEAE

- Agathelpis dubia (L.) Hutch., T 10802, 11193
 Cromidion
 microechinos Hilliard, Esterhuysen 34399, 35073
 plantaginis (L.f.) Hilliard, Esterhuysen 13089
 Dischisma ciliatum (P.J.Bergius) Choisy, T 11398, 12002
 Gosela eckloniana Choisy, T 6204, 10648, 11178, 11417
 Hebenstretia
 lanceolata (E.Mey.) Rolfe, Bond & Goldblatt 1984
 neglecta Roessler, Leopoldt 560 (p.p.)
 paarlensis Roessler, T 11918
 robusta E.Mey., PRECIS 1990
 sp., Kruger 1676
 Microdon
 bracteatus (Thunb.) Hartley, T 7466, 10646, 10829, 10879, 11132, 11181
 cylindricus E.Mey., T 8480
 Selago
 ascendens E.Mey., Forestry 1984
 brevifolia Rolfe, Forestry 1984
 burmannii Choisy, Bond & Goldblatt 1984
 glomerata Thunb., T 10517, 11274
 glutinosa E.Mey., T 10486, 10650, 11044
 guttata E.Mey., T 11895, 11896
 heterophylla E.Mey., Bond & Goldblatt 1984
 hispida L.f., Compton 9616
 lamprocarpa Schltr. ex Rolfe, T 11415
 laxiflora Choisy, T 10608, 10653
 minutissima Choisy, T 10657
 oresigena Compton, Bond & Goldblatt 1984
 ovata Rolfe, T 11045
 rudolphii (Hiern) Levyns, T 10755, 10839, 11276
 scabrida Thunb., T 6187, 7492, 11881
 serrata P.J.Bergius, T 10858, 11177
 spuria L., T 10875, 11176
 stricta P.J.Bergius, Lewis (BOL 22276), Welman 00150
 tephrodes E.Mey., PRECIS 1990
 triquetra L.f., Johnson 523
 sp., T 11942

SOLANACEAE

- Lycium spp. (genus under revision), T 10614, 10944
 Solanum
 retroflexum Dunal, T 11757
 tomentosum L., T 10583

STERCULIACEAE

- Hermannia
 alnifolia L., T 11345, 11352
 aspera Wendl., T 10568, 10654, 10988, 12119
 cuneifolia Jacq., T 10559
 denudata L.f., T 7533, 10631
 diffusa L.f., T 10623
 helicoidea I.Verd., Pillans 9063, R
 multiflora Jacq., Forestry 1984
 odorata Aiton, T 10672
 cf. prismatocarpa E.Mey. ex Harv., T 11564
 rigida Harv., De Winter & Verdoorn 9044, Oliver (STE 33288)
 scabra Cav., T 5071, 7504, 10965, 11772
 sisymbriifolia (Turcz.) Hochr., T 7524, 10597, 10712, 11007, 11532
 trifurca L., T 11339

STILBACEAE

- Stilbe albiflora E.Mey., T 10807, 11228

THYMELAEACEAE

- Gnidia
 geminiflora E.Mey. ex Meisn., T 5118, 10696
 oppositifolia L., T 10498
 Lachnaca
 capitata (L.) Meisn., Leopoldt (STEU 25886)
 filamentosa (Thunb.) Meisn., T 1613, 6154, 10675
 funicaulis Schinz, T 11775
 globulifera Meisn., T 10601, 10728, 10973
 laniflora (C.H.Wright) Bond, T 5089, 6146, 10686, 10843
 marlothii Schltr., T 5103, 6821
 naviculifolia Compton, T 10510, 10676, 11058
 penicillata Meisn., Forsyth 35
 striata (Lam.) Meisn., Bolus 9087
 sp. nov., T 10871
 Passerina
 glomerata Thunb., T 10483, 10618, 10841, 11154
 vulgaris Thoday, T 11663, 11858
 sp., T 12259
 Struthiola
 ciliata (L.) Lam., T 7498, 10638, 11061, 11403, 11567, 11761
 leptantha Bolus, T 5079, 11761, 12072
 lineariloba Meisn., PRECIS 1990
 myrsinites Lam., T 11116

URTICACEAE

- Didymodoxa capensis (L.f.) Friis & Wilmot-Dear, T 11795

VISCACEAE

- Viscum pauciflorum L.f., T 11486, 11839, 12000

ZYGOPHYLLACEAE

- Seetzenia lanata (Willd.) Bullock, Bodkin (Bolus 8931), Goldblatt 5652
 Zygophyllum
 flexuosum Eckl. & Zeyh. (?), T 10639 (genus under revision)
 foetidum Schrad. & Wendl., Boucher 3091
 fulvum L., Bos 3018, Compton 6924, Esterhuysen 20504, Wagener 158
 morgsana L., Leopoldt 878
 pygmaeum Eckl. & Zeyh., T 11427
 sessilifolium L. (?), PRECIS 1990 (genus under revision)
 sonderi H.Eichler (?), Pocock 699 (genus under revision)

APPENDIX 1.—Synoptic phytosociological table for plant communities in the northern Cederberg

Community number	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	
A. Diagnostic species for Community 1																											
<i>Brabejum stellatifolium</i>	5																										
<i>Prionium serratum</i>	4																										
<i>Platycaulos compressus</i>	4																										
<i>Freylinia lanceolata</i>	3																										
<i>Phragmites australis</i>	3																										
<i>Imperata cylindrica</i>	2																										
<i>Cliffortia strobilifera</i>	2																										
<i>Rhus angustifolia</i>	2																										
<i>Juncus lomatosphyllus</i>	2																										
<i>Psoralea oreopola</i>	2																										
B. Species common to Communities 2 & 3																											
<i>Pteridium aquilinum</i>	4	4												1													
<i>Elegia capensis</i>	1	5																									
<i>Berzelia lanuginosa</i>	1	2											2														
<i>Psoralea pinnata</i>	4																										
C. Species common to Communities 2 & 3																											
<i>Todea barbara</i>		4	3																								
<i>Halleria lucida</i>		4	3																								
<i>Blechnum</i> sp. (188.7)		4	1																								
D. Species common to Communities 1, 2 & 3																											
<i>Metrosideros angustifolia</i>	5	5	5																								
<i>Brachylaena neriifolia</i>	5	4	3																								
<i>Calopsis paniculata</i>	5	4	2																								
<i>Erica caffra</i>	3	2	2																								
<i>Myrica serrata</i>	1	4	2																								
<i>Buddleja salviifolia</i>	1	1																									
E. Diagnostic species for Community 4																											
<i>Euclea acutifolia</i>				4				1						1													
<i>Melanthus major</i>				3																							
<i>Rhus tomentosa</i>	1	2		3				1						1													
<i>Euclea lancea</i>				2																							
<i>Anisodonteia bryoniifolia</i>				2			1																				
<i>Viscum pauciflorum</i>				2																							
<i>Stachys aethiopica</i>				1																							
<i>Knowltonia vesicatoria</i>				1																							
<i>Ehrharta</i> sp.				1										1													
F. Species common to Communities 3 & 4																											
<i>Olea europaea</i> subsp. <i>africana</i>				5	5																						
<i>Chironia baccifera</i>				2	5			1			1			2	1												
<i>Hartogiella schinoides</i>				5	4		1																				
<i>Secamone alpini</i>	2			4	4																						
<i>Euclea natalensis</i>				1	4																						
<i>Diospyros austro-africana</i>				1	3																						
<i>Protasparagus retrofractus</i>				1	3																						
<i>Kiggelaria africana</i>				1	2																						
<i>Senecio vestitus</i>				3	2																						
<i>Myrsiphyllum kraussianum</i>				2	1		1																				
<i>Colpoon compressum</i>				1	1																						
<i>Lidbeckia lobata</i>				1	1																						
<i>Protasparagus aethiopicus</i>				2	1																						
<i>Solanum tomentosum</i>				1	1																						
<i>Zantedeschia aethiopica</i>				1	1																						
<i>Crassula decumbens</i>				1	1																						
<i>Hemimeris montana</i>				1	1																						
G. Species common to Communities 1, 2, 3 & 4																											
<i>Clutia pulchella</i>	4	5	2	2																							
<i>Rhus undulata</i>	1	2	3	5				1		1				1									+				
<i>Podocarpus elongatus</i>	1	4	4	2																							
<i>Cassine peragua</i>	2	2	3																								
<i>Indigofera frutescens</i>	2	2	2											1									+				
H. Diagnostic species for Community 5																											
<i>Aloe mitriformis</i>				1	3																						
<i>Ruschia decurrens</i>					4			2																			
<i>Conophytum minusculum</i>					3																						
<i>Crassula rupestris</i>					2																						
<i>Albuca cooperi</i>					2																						
<i>Ornithogalum</i> cf. <i>conicum</i>					2																						

APPENDIX 1.—Synoptic phytosociological table for plant communities in the northern Cederberg (continued)

[illegible]

APPENDIX 1.—Synoptic phytosociological table for plant communities in the northern Cederberg (continued)

[illegible]

APPENDIX 1.—Synoptic phytosociological table for plant communities in the northern Cederberg (continued)

Community number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
AI. Diagnostic species for Community 18 continued																										
<i>Pharnaceum incanum</i>								1										1								
<i>Lachnospermum fasciculatum</i>																		1								
<i>Lobelia coronopifolia</i>																		1								
<i>Syncarpha canescens</i>																		1								
<i>Dischisma ciliatum</i>																		1								
<i>Serruria aitonii</i>																		1								
<i>Gosela eckloniana</i>																		1								
<i>Stipagrostis zeyheri</i>																		1								
<i>Pentaschistis aristidoides</i>																		1								
<i>Anthospermum bergianum</i>																		1								
<i>Ursinia pilifera</i>																		1								
<i>Helichrysum moesianum</i>					1													1								
<i>Moraea</i> spp.																		1								
<i>Aspalathus vulnerans</i>							2											1								
<i>Adenogramma glomerata</i>											2							1								
<i>Grisebachia ciliaris</i>																		1								
AJ. Species common to Communities 17 & 18																										
<i>Muraltia rhamnoides</i>																		2	1							
<i>Arctotis diffusa</i>												1						1	2							
<i>Lobostemon echinoides</i>																		1	1							
<i>Gymnodiscus capillaris</i>																		1	2							
<i>Selago spuria</i>																		1	1							
AK. Species common to Communities 9 to 18																										
<i>Manulea laxa</i>																		1	+							
<i>Ischyrolepis unispicata</i>								4	+			1						5	2			2				
<i>Gnidia geminiflora</i>								5					2					4	2							
<i>Pentaschistis viscidula</i>									+			3						2	2							
<i>Cymbopogon marginatus</i>												2						1	2	2						
<i>Senecio erosus</i>											2	1			1			1	1							
<i>Senecio arenarius</i>											4	1						+								
AL. Species common to Communities 8, 11, 13, 14, 17 & 18																										
<i>Merxmüllera stricta</i>								2	2		1		4	3	2			3	2							
<i>Lasiochloa longifolia</i>							2	4	2		+		2	3				2	1							
<i>Lampranthus laetus</i>							2	1			2			2				1	3							
<i>Ficinia dunensis</i>							1				+							2	2							
<i>Cliffortia polygonifolia</i>							2							2				+								
AN. Species common to Communities 5 to 18																										
<i>Thesium subnudum</i>				1	3	2	2			1	2							3	2							
<i>Chrysocoma ciliata</i>				1		2	2	4				2	1					1	2							
<i>Gazania serrata</i>					1	1		1			+		1					3	1							
<i>Pteronia camphorata</i>					1	1		1		4	1	4						1	1							
<i>Ruschia dichroa</i>					5													1	2							
<i>Pelargonium scabrum</i>					1		2		1		+		1	2				1								
<i>Cyphia digitata</i>					2				2		+		2	1				+								
AN. Diagnostic species for Community 19																										
<i>Elytropappus scaber</i>																		5								
AO. Species common to Communities 18 & 19																										
<i>Lightfootia</i> cf. <i>spicata</i>								1										1	3	3						
<i>Agathosma pubigera</i>													1					1	5							
<i>Diosma meyeriana</i>					1		2					2						1	1	2						
<i>Aspalathus linearis</i>																		1	3							
AP. Species common to Communities 5 to 19																										
<i>Ehrharta calycina/villosa</i>				1	5	5	5	5	5	2		5	4				5	5	3		3					
<i>Ischyrolepis sieberi</i>					3	3	4	2		5	3	5		2	3	4		2	5					3		
<i>Stoebe intricata</i>					1	5	4	2						1				1	+	3						
<i>Ruschia tardissima</i>						2	3	1		+								1								
AQ. Species common to Communities 19 & 20																										
<i>Hypodiscus neesii</i>								2		+								+	5	2						
<i>Selago lamprocarpa</i>						1	3											+	5	4						
<i>Lobelia capillifolia</i>										+								3	2							
AR. Species common to Communities 18, 19 & 20																										
<i>Tetraria nigrovaginata</i>							2	1										4	3	4						
<i>Pelargonium coronopifolium</i>										+	2							3	2	2		2				
<i>Macrostylis tenuis/decipiens</i>										+			1	2				3	4	4						
<i>Rafnia cuneifolia</i>																		1	2	2						
<i>Haplocarpha parvifolia</i>											2							1	2							

APPENDIX 1.—Synoptic phytosociological table for plant communities in the northern Cederberg (continued)

Community number	1	2	3	4	5	6	7	8	9	0	1	1	1	1	1	1	1	2	2	2	2	2	2	
AS. Species common to Communities 13, 14, 17, 18, 19 & 20																								
<i>Willdenowia arescens</i>										+		4	1					2	4	3	4			
AT. Species common to Communities 6 to 20																								
<i>Helichrysum cylindriflorum</i>						1	3	2	4		+		4	5				2	1	2	2			
<i>Aspalathus divaricata</i>						4	1												2		4			
<i>Protea laurifolia</i>						2		2	5		1								1	2	5			
AU. Diagnostic species for Community 21																								
<i>Centella</i> cf. <i>recticarpa</i> (11811)																		+			5			
<i>Lachnaea globulifera</i>																					5			
<i>Bobartia rufa</i>																					5			
<i>Aspalathus sericea</i>																					5			
AV. Species common to Communities 18, 19, 20 & 21																								
<i>Elytropappus glandulosus</i>								1					2	1				1	2		4	5	2	
<i>Thesium nudicaule</i>																			2	3		5		
<i>Simoechilus puberulus</i>										+									1	2		3		
AW. Species common to Communities 8 to 21																								
<i>Tetraria cuspidata</i>								2			4		4	2	3			4	2	5	5	5		
<i>Corymbium africanum</i>								3	4		+		3	2				2	2			5		
<i>Ischyrolepis capensis</i>								5	4										1		2	3		
<i>Muraltia heisteria</i>						3					2	3	2						1	4		3		
<i>Pentaschistis curvifolia</i>						2						2						1	1	4	2	3		
<i>Ursinia punctata</i>						1			2	2	5	1	2							2	4	3		
<i>Tritoniopsis antholyza</i>						2	2					1							1		4	3		
<i>Lobostemon trichotomus</i>						1		1										2	1	3	2	3		
<i>Ficinia filiformis</i>						1		1				1	2				1					5		
<i>Phyllica villosa</i>						2			1									1		3	2			
<i>Osteospermum bidens</i>						2				1	2		1						2		5			
AX. Diagnostic species for Community 22																								
<i>Staberoha aemula</i>																					5	2	5	
<i>Willdenowia sulcata</i>														2			1	+			5			
<i>Tetraria crinifolia</i>																					5			
AY. Species common to Communities 11 to 22																								
<i>Ficinia petitiiana</i>						2					1	3		1	2			2	3	2		2		
<i>Prismatocarpus fruticosus</i>											2	3		2	2			1	1	2	2	5	2	
<i>Thesium strictum</i>											1			2	2				+	3	2	3		
<i>Dilatris ixioides</i>											+								+	2	5	3	2	
<i>Selago rudolphii</i>																		1	1		2	2		
AZ. Species common to Communities 20 to 23																								
<i>Elegia filacea</i>											+	4						1	1		5	5	5	
BA. Species common to Communities 9 to 23																								
<i>Cannomois parviflora</i>						2		4	4	4	5		2	5	4		3	3	5	5	5	2	5	2
<i>Ficinia deusta</i>						2	1	2		2	4		2	4	3		4	3	3	4	5	2		
<i>Restio filiformis</i>								2	2	4			1	3			1	+	3	5	5	4	5	2
<i>Struthiola ciliata</i>						1			1	2							1	2	5	4		2		
<i>Agathelpis dubia</i>								4		1	4		1	2			2	1	2					
<i>Ischyrolepis virgea</i>								2	1	4			2	2						5		5		
<i>Ficinia cedarbergensis</i>									1	4			2	1			+	3	5			2		
<i>Hypodiscus laevigatus</i>									+	2			2					2			5	4	4	2
<i>Poaceae</i> spp.								1			5	1					1						2	
BB. Diagnostic species for Community 24																								
<i>Restio occultus</i>	2																						3	
<i>Elegia asperiflora</i>																							4	
BC. Species common to Communities 20, 22 & 24																								
<i>Tetraria</i> sp. nov. (11230)												2								5		4	5	
BD. Species common to Communities 8 to 24																								
<i>Tetraria ustulata</i>								2	2	2			2	3			1	2	5	5	5		2	
BE. Species common to Communities 5 to 24																								
<i>Cliffortia ruscifolia</i>				1	2	4	5	4	5	4	4	5	5	4	5	4	2	1	4		3		2	
<i>Anthospermum aethiopicum</i>				1	2	5	5	2	4		4	5	3	4			2	3	5	4	3		4	
<i>Stoebe plumosa</i>				1	1	2	2	2	4	4	5	5	5	5	2			2	5	4		5	2	4
<i>Metalasia densa</i>					1	3	4	2		3	5	5	2	3	1		3	1	5	4		4	4	2
<i>Calopsis viminea</i>					1	4	1	2	2	1	4	2	1	2			4	4	5	4				
<i>Restio strobilifer</i>																							5	
<i>Babiana</i> sp.					4	5	5	1	4	4	1		5	1			1	+						
<i>Oxalis</i> spp.					1				4		1		5	4				1						
<i>Pentaschistis</i> spp.				1		1	2				1		2	1		1	3	1			5		2	

APPENDIX 1.—Synoptic phytosociological table for plant communities in the northern Cederberg (continued)

Community number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
BF. Diagnostic species for Community 25																											
<i>Restio strobilifer</i>																									5		
<i>Elegia neesii</i>																1								2	5		
BG. Diagnostic species for Community 26																											
<i>Pentaschistis densifolia</i>									2																	5	
<i>Laurentia arabidea</i>					1																					4	
<i>Drosera</i> sp.										+																4	
BH. Species common to Communities 5 to 26																											
<i>Ischyrolepis curviramis</i>						1		2			5		3				2	2		5		5		4	5	5	
<i>Epischoenus dregeanus</i>											+	4		1		1	2			2		2	2	2	3		
BI. Non-diagnostic species																											
<i>Rhus dissecta</i>					3		2	2	2						1				1	3							
<i>Trachyandra</i> sp.					3						2	+			1			2	1			3		2			
<i>Thesium carinatum</i>						2			4	2	1	4			1	3			1								
<i>Aspalathus</i> spp.								1			+				2				3	+							
Geophyte spp.								2			+				2				1	+				5		2	
<i>Cannomois virgata</i>	4	2									1							1					2				
Apiaceae spp.										5				4	2				+								
<i>Crassula</i> spp.					1					2	+			2	1				1								
<i>Paranomus bracteolaris</i>							1	2		2		1		1					+								
Monocotyledonae spp.									4		+				2												
<i>Crassula muscosa</i>					1		2		2										+								
<i>Oxalis obtusa</i>											1								3								
<i>Aspalathus ciliaris</i>									2					4													
<i>Haemanthus</i> sp.			1	1															1								
<i>Pelargonium</i> spp.					1				2					2					1	+							
<i>Salvia africana-caerulea</i>				1					2					2	1												
<i>Acrosanthes humifusa</i>																					2			2			
<i>Albucca</i> sp.						1	1				+			1													
<i>Arctotis laevis</i>					1				1					1													
<i>Caesia contorta</i>																			+			2			2		
<i>Crassula umbella</i>			1	1							+								1								
<i>Erica articularis</i>								2											+	2							
<i>Erica senilis</i>																		1	+				2	2			
<i>Erica</i> sp.																		1	+				2				
<i>Helichrysum</i> spp.										2								1								2	
<i>Leucadendron concavum</i>																											
<i>Leucadendron loranthifolium</i>								1											1			2					
Mesembryanthemaceae spp.								2		2	+							1									
<i>Oftia africana</i>					1			1																			
<i>Othonna amplexifolia</i>			1	1							+									+							
<i>Pellaea pteroides</i>			1	1	1										1												
<i>Pentaschistis thunbergii</i>															1								2				
<i>Senecio</i> sp.											+						1	1								2	
<i>Cuscuta nitida</i>								1			+										2						
Cyperaceae spp.			1							2																2	
<i>Eremia totta</i>														2	1	2											
<i>Helichrysum asperum</i>				1		1					+																
<i>Heliophila scoparia</i>								1							1								3				
<i>Hypodiscus argenteus</i>											+												5				
<i>Rafnia amplexicaulis</i>															1				1								
<i>Sutera hispida</i>				1							+			2													
<i>Syncarpha variegata</i>																							3				
<i>Thamnochortus acuminatus</i>																				+							
<i>Ursinia anthemoides</i>						1					+								1	+							
<i>Ursinia</i> sp.												+								1	+						
<i>Zygophyllum flexuosum</i>									1											1	+						
<i>Aspalathus aristata</i>											+									1	+						
<i>Brachycarpaea juncea</i>															1												
<i>Euphorbia tuberosa</i>									1											+							
<i>Euryops othonnoides</i>										2		+															
Campanulaceae spp. (11471)								2													2						
<i>Cissampelos capensis</i>				1																	+						
<i>Crassula pustulata</i>							1																				
<i>Felicia ferulacea</i>											+				1												
<i>Helichrysum acrophilum</i>											+													2			

APPENDIX 1.—Synoptic phytosociological table for plant communities in the northern Cederberg (continued)

Community number	1	2	3	4	5	6	7	8	9	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2
BI. Non-diagnostic species continued																								
<i>Helichrysum</i> sp. (11812)																	+							
<i>Hermannia alnifolia</i>				1																				
<i>Hermannia aspera</i>							2							1										
<i>Hermannia scabra</i>								1								1								
<i>Ifloga ambigua</i>																	+							
<i>Indigofera</i> spp.								1						1										
<i>Lachnaea filamentosa</i>												2									2			
<i>Lachenalia</i> sp.														1										
<i>Mohria caffrorum</i>				1									2											
Orchidaceae spp.										+							+							
<i>Passerina vulgaris</i>														1			+							
<i>Pentaschistis colorata</i>																	+							
<i>Prismatocarpus</i> sp. (10859)																	+							
<i>Protea magnifica</i>												2				1						2		
<i>Protea repens</i>												2												
<i>Stoebe</i> sp.								1									+							
<i>Sutera</i> sp.				1							+													
<i>Tetradlea bolusii</i>										+							1							
<i>Thesium oresigenum</i>										+						1								
<i>Tritoniopsis</i> sp.							2												2					

APPENDIX 2.—Phytosociological table for plant communities in the northern Cederberg. See Chapter 3 for cover abundance values and environmental codes

[illegible]

[illegible]

APPENDIX 2.—Phytosociological table for plant communities in the northern Cederberg. See Chapter 3 for cover abundance values and environmental codes (continued)

[illegible]

APPENDIX 2.—Phytosociological table for plant communities in the northern Cederberg. See Chapter 3 for cover abundance values and environmental codes (continued)

[illegible]

APPENDIX 2.—Phytosociological table for plant communities in the northern Cederberg. See Chapter 3 for cover abundance values and environmental codes (continued)

[illegible]

APPENDIX 2.—Phytosociological table for plant communities in the northern Cederberg. See Chapter 3 for cover abundance values and environmental codes (continued)

Community number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	Heterogeneous relevés		
Relevé number	111111	111	11	1111	111111	11	111111	11	111111	1	111111111111	111	111	1111	1111	1111	1111111111	11111111	1111167788923334577	66775	22990	556	767	67	556	1223567002345568			
Bl. Non-diagnostic species continued	123567	891	04500	901237025904	8173456	38915936	4568	4567890134524	612	028	37890171371236957278	7823	912	245789453694564	2448	57269	0289045780123	12456896678129634693612	7845	243	78	785	190	359	70	083	37136610064091510		
<i>Aspalathus ciliaris</i>								0	+	0			1					+									0	+	+
<i>Haemanthus</i> sp.			+		+	+																							
<i>Pelargonium</i> spp.																													
<i>Salvia africana-caerulea</i>				+									+					+											
<i>Acrosanthes humifusa</i>														1															
<i>Albuca</i> sp.																													
<i>Arctotis laevis</i>																													
<i>Caesia contorta</i>				+	0			0																					
<i>Crassula umbella</i>				+																									
<i>Erica articularis</i>																													
<i>Erica senilis</i>																													
<i>Erica</i> sp.																													
<i>Helichrysum</i> spp.																													
<i>Leucadendron concavum</i>																													
<i>Leucadendron loranthifolium</i>																													
<i>Mesembryanthemaceae</i> spp.																													
<i>Oftia africana</i>																													
<i>Othonna amplexifolia</i>																													
<i>Pellaea pteroides</i>																													
<i>Pentaschistis thunbergii</i>																													
<i>Senecio</i> sp.																													
<i>Cuscuta nitida</i>																													
<i>Cyperaceae</i> sp.																													
<i>Eremia totta</i>																													
<i>Helichrysum asperum</i>																													
<i>Heliophila scoparia</i>																													
<i>Hypodiscus argenteus</i>																													
<i>Rafnia amplexicaulis</i>																													
<i>Sutera hispida</i>																													
<i>Syncarpha variegata</i>																													
<i>Ursinia</i> sp.																													
<i>Zygophyllum flexuosum</i>																													
<i>Thamnochortus acuminatus</i>																													
<i>Ursinia anthemoides</i>																													
<i>Aspalathus aristata</i>																													
<i>Brachycarpha juncea</i>																													
<i>Euphorbia tuberosa</i>																													
<i>Euryops othonnoides</i>																													

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